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UNITED STATES ATOMIC ENERGY COMMISSION

Nuclear Science Abstracts

Vol. 4 No. 8
Aug. 28, 1950

Technical Information Division, OSE, Oak Ridge, Tennessee

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2113 Splenic Changes in CF1 Female Mice over a Forty-one Day Period Post X-irradiation. Robert E. Carter. AECU-709, nd. 9p.

This study was undertaken to determine if, at any time in the immediate post exposure period, weight changes in the spleen or white pulp atrophy of CF1 female mice could be related to the amount of x-irradiation the animals received. Splenic weight changes and white pulp-red pulp ratio changes over a 41-day period post irradiation are presented. Initial studies of splenic weight changes indicate that between 3 and 8 days post irradiation the decrease in splenic weight may serve as a remarkably accurate indication of the radiation received. The changes in the pulp ratios of the spleen were not deemed of sufficient promise to warrant further investigation. Possible applications of this phenomenon to the field of radiation and biology are mentioned. 13 references.

2114 The Cytogenetic Effect of Slow Neutrons. Alan D. Conger and Norman H. Giles, Jr. ORNL-409, Feb. 6, 1950. 55p.

The cytogenetic effect of thermal neutrons from a special facility in the thermal column of the Oak Ridge nuclear reactor has been investigated. The production of chromosomal aberrations, both chromatid and chromosome types, in Tradescantia microspores has been compared with the production of the same aberrations by x-rays. Calculations of the number of rep absorbed from thermal neutron capture in tissue indicate that three elements, hydrogen, nitrogen, and boron are responsible for about 99% of the ionization dose produced by neutron capture, and that about 77% of this dose is due to the protons and α rays from nitrogen and boron capture reactions. These conclusions are substantiated biologically by the observed linear increase of exchange aberrations with dose, which is characteristic of particulate radiation (with electromagnetic radiation, exchange aberrations increase as a power of the dose). An equivalence of thermal neutrons/x-rays has been derived by comparing the production of chromosomal aberrations by the two radiations. The best value seems to be $\sim 5 \times 10^9$ thermal neutrons per cm^2 = 1 r of x-rays in biological effect; this would make the 8-hr tolerance dose (the same amount of effect as 0.1 r of x-rays) as based on this effect $\sim 5 \times 10^8$ thermal neutrons per cm^2. A comparison of the x-ray equivalent effect produced by unit dose of thermal neutrons with the calculated number of rep generated by the same dose shows that thermal neutrons are about 11 times as efficient as x-rays per unit dose in producing this biological effect. If only the nitrogen protons and boron α rays from thermal neutron capture are considered, their efficiency compared with x-rays seems to be about 15/1. These biological efficiencies are about 3 to 4 times as great as have been observed when the same types of radiations were delivered from external sources. It is believed that this difference in the effectiveness of protons and α rays when they are administered to a tissue from an external source and these same radiations when they originate from the atoms of the tissue itself is not due to any difference in the effect of the protons and α rays themselves, but is due to a difference in their place and manner of origin. 14 references. (auth)

2115 The Effect of Radiations on Genetic Mechanisms of Paramecium Aurelia. R. F. Kimball. ORNL-565, Feb. 15, 1950. 17p.

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Paramecium presents several advantages for analyzing the effect of radiation on genetic mechanisms. One of these advantages is the possibility of studying the effects of radiation on both the nuclear and the cytoplasmic mechanisms of inheritance. Cytoplasmic inheritance has been studied fairly extensively in this organism previously. The purpose of this paper is to present some results of studies on the effects of radiation on both types of inheritance, and in so doing, give some idea of the possibilities of the material. Inactivation studies have been carried out, in a preliminary way, using ultraviolet from a germicidal lamp having its major output around 2537 A. Inactivation occurs but the data are still not sufficient to define with any exactness the form of the curve. There is a possibility that it will turn out to be of the exponential type expected for single event occurrence. The rest of the work is concerned with mutations induced in the micronucleus by β radiation. An external source of β radiation was used by means of the phosphorus plaque technique developed in this laboratory.

2116 Effects of Radiation on Mitosis. J. Gordon Carlson. ORNL-570, Feb. 15, 1950. 22p.

The effects of x- and ultraviolet radiations upon the mitosis of grasshopper embryo neuroblasts is discussed. The approach is primarily cytological and is concerned with how the individual cell is affected by radiation. The inhibition of mitosis by x-irradiation is noted, and the effects of total dosages, dosage rates, and the mitotic stage at which the x-radiation is administered is pointed out. A certain "critical period" for inhibiting mitosis—late prophase—has been noted. The effects of ultraviolet radiation are compared with x-radiation. Instead of a clear-cut mitotic stoppage at a "critical period," cells throughout most of interphase and prophase may be retarded mitotically by relatively low dosages of ultraviolet radiation. The author concludes that although there is much information available on the manner in which various radiations affect mitosis, the mechanism by which excitation and ionization of atoms within the cell are transformed into large scale mitotic effects is not understood. He states that the effectiveness of very low ionizing radiation dosages in interfering with enzyme systems is highly suggestive.

2117 The Effect of Oxygen Concentration on the Rate of X-ray Induced Mutations in Drosophila. William K. Baker and Elizabeth Sgourakis. ORNL-575, Feb. 1, 1950. 18p.

A striking reduction has been found in the number of recessive sex-linked lethal mutations induced in Drosophila melanogaster males when they are exposed to x-rays while in an atmosphere of low oxygen concentration. Although an increased number of mutations were induced in flies irradiated in oxygen at 2°C over those treated in oxygen at 27°C, this increase was not due to the temperature per se but rather it was apparently caused by a higher oxygen tension within the irradiated sperm at the lower temperature. Additional evidence also indicates that fewer dominant lethal mutations and chromosome aberrations are induced in flies maintained in a near oxygen-free atmosphere during irradiation. (auth)

2118 Resuscitation of Heat-Inactivated Seeds by X Radiation. S. R. Suskind. ORNL-579, Feb. 9, 1950. 21p.

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Experiments to determine the effects of post-irradiation on wheat and barley seeds, following sublethal and lethal heat treatment, have been performed in order to investigate the previously reported "resuscitation" of heat-inactivated seeds by x-radiation (Caldicott and Smith, J. Hered. 39, 173-6 and 195-8(1948)). These results were not confirmed. A shift in lethal temperature may be explained by a variation in moisture content in the seeds, increased humidity resulting in lower lethal temperature.

2119 Internal Dose Determinations of Several Radioisotopes. Charles H. Perry. ORNL-591, Feb. 27, 1950. 97p.

Part I. Methods of calculation and tabulated results are presented for tissue doses produced by radioisotopes of those elements which are common to body metabolism. Factors of safety are suggested. Experimental data concerning the biological decay constants of the elements in the various organs were not available; therefore it was necessary to make approximations based on assumptions. These included the assumption that the biological decay constant is exponential in character and that the biological decay for any quantity of the element within the organ. Part II. Calculations are presented for tissue doses produced by dusts of insoluble and soluble compounds of radioactive uranium isotopes (U^{234}, U^{235}, and U^{238}). These calculations are based on UO_2 dust experimental data.

2120 X-ray Induced Development Abnormalities in the Mouse and Their Use in the Analysis of Embryological Patterns. I. External and Gross Visceral Changes. Liane Brauch Russell. ORNL-595, Feb. 17, 1950. 76p.

Hard ionizing radiation is useful as an injurious agent in the study of mammalian development since its action is largely general, and the selective response of structures may be used for the interpretation of intrinsic patterns of sensitivity in the organism. The moment of interference may, moreover, be accurately timed and correlations with the characters produced lead to the discovery of sensitive periods in particular developmental processes. Four-hundred and twenty newborn mice, irradiated with 250 kvp x-rays during intrauterine life, were studied externally, by gross dissection, and skeletally. Only the first two types of findings are described in this paper. Treated stages differed by 24-hr intervals and ranged from day ½ to day 13½ after fertilization. Dosages employed were 200 r (100 r in a few cases) for a survey of all stages; 300 and 400 r for dosage comparisons at the last five stages. The irradiated embryos and controls were hybrids between 2 pure strains (C57 black ♀ × NB♂) and came exclusively from second litters. Irradiation with 200 r before implantation (½ - 4½ days), and with 300 r at 9½ days increases prenatal mortality in early and late stages, respectively. The peak incidence of natal death follows irradiation on days 9½ and 10½. Considerable depression of birth weight occurs as a consequence of irradiation between days 8½ and 13½. Birth weight curves for different doses are unimodal and roughly parallel. They indicate that maximum depression would follow irradiation at a stage intermediate between days 10½ and 11½. Considering two main types of effect following irradiation — namely, prenatal mortality and abnormality at birth — the intrauterine development of the mouse seems to be divisible into three

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broad phases: (1) days ½ to 4½ (possibly 5½) — considerable incidence of probably early death but 98% (100% in external characters) normality among survivors to term; (2) days 6½ to 13½ — little or no prenatal death but high incidence of abnormalities at birth; (3) days 14½ to birth (data from preliminary experiment) — neither prenatal death nor visible abnormalities at term with doses of 300 r and below; abnormalities (cataract, hydrocephalus, skin defects) do, however, develop later in life. Irradiation during the 6½ to 13½ day phase reveals a definite pattern of critical periods in the formation of a variety of characters of the newborn. Externally apparent and visceral abnormalities produced with considerable incidence in consequence of treatment on a definite day (or days) include: microphthalmia, coloboma, narrow iris, vaulted cranium, snout and nostril abnormality, cranial blister, narrow head, open eyelids, spina bifida, small or imperforate anus, hydronephrosis and/or hydroureter, reduction in tail length, abnormalities in tail shape, overgrowth in feet (including polydactyly), digital reductions (including oligodactyly), and limb abnormalities. Abnormalities, each of which occurred in only one animal, include: pseudencephaly, hypospadias with persistence of cloaca, and situs inversus. Using the evidence of critical periods, some of the induced abnormalities have been linked with certain phases, or physical events, in the chain of processes known to lead to the formation of affected characters. Sensitivity in some cases occurs at the time of visibly fastest degree of change in a primordium (e.g., the critical period for digital reductions corresponds to the time of growth of limb buds; the second phase of susceptibility to tail reduction is coincident with early tail growth). In other cases, sensitivity is not predictable from known facts of descriptive embryology (e.g., critical period for overgrowth in feet, first phase of susceptibility to tail reduction — both occurring before appearance of visible primordia). Increase in incidence of abnormality with increase in dose indicates that, even where there is an all-or-none effect (actually rarer than graded response), animals are continuously distributed with regard to sensitivity. The sensitivities of certain processes are low and show little scatter. There are both close similarities and striking differences between radiation induced abnormalities and the effects of known genes. 34 references.

2121 Study of the Effects of Varying Oxygen Tensions on The Response of Mammalian Tissues to Roentgen Irradiation. Andrew H. Dowdy, Leslie R. Bennett, and Sarah M. Chastain. UCLA-55, Jan. 3, 1950. 20p.

The effects of brief extreme anoxia on the LD_{50} and on the radiation syndrome observed in mammals after total body roentgen irradiation has been investigated. The 30-day LD_{50} for rats irradiated in 5% oxygen appears to be between 1200 and 1400 r as contrasted with the LD_{50} of slightly higher than 600 r in irradiated control rats. Anoxia produced by injection of NaCN failed to protect rats from roentgen irradiation. These experiments support the theory that irradiation injury results from radio-chemical reactions involving free oxygen. 17 references. (auth)

2122 A Comparison of the Response of Normal and Hypothyroid Mice to Acute Whole Body Roentgen Radiation. Thomas J. Haley, Samuel Mann, and Andrew H. Dowdy. UCLA-61, Feb. 20, 1950. 9p.

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The ability of antithyroid drugs to protect animals against the lethal effects of x-irradiation has been investigated with adult mice. It has been concluded from the results that the hypothyroid state does not protect the mouse from x-irradiation damage. The amount of available oxygen and not its rate of utilization determines the extent of such damage.

2123 Absorption Effects in Volume Irradiation of Microorganisms. Harold J. Morowitz. Science 111, 229-30(1950) Mar. 3.

From target theory a relation has been derived which gives the percentage of organisms, suspended in a medium, which survive irradiation of a given dosage (see Pollard and Forro, Science 109, 374(1949)). This derivation is strictly valid only if the suspending medium does not absorb the radiation, or if the organisms are spread out in a negligible thickness of the suspending material (surface irradiation). The author derives a corresponding expression for absorbing suspending materials, for the two cases in which the organisms are fixed in the suspending material, and for the case in which the organisms are constantly stirred.

2124 Action of Roentgen Irradiation of the Spleen on Easily Isolated Blood Iron. C. Scartozzi and G. Silvestri. Patologia Sperimentale 36, 65-80(1948) (in Italian).

A study was made concerning the influence of the spleen on hemocatheresis by examining the behavior of easily isolated blood iron following x-irradiations of the spleen. Rabbits were given excitant and depressant doses of roentgen rays to the spleen; some of the animals also were submitted to irradiation of the liver and gluteal muscles, while others acted as controls. Three days after the irradiation of the spleen with 21 or 28 r (excitant dose) a marked increase in iron was observed lasting 15-25 days, and followed by a return to earlier values. A second irradiation was performed with 110 r (depressant dose), 140 days after the first irradiation; there was a marked lowering of the easily isolated iron of total blood eight days after this irradiation. The fall continued for successive days and ranged from values of 1,500 and 2,000 to values of 0.560 and 0.630. The easily isolated iron values were still very low 45 days after the x-ray treatment, and approached the original values only after 65 days. A small x-ray dosage (excitant dose) to the liver of rabbits did not produce any marked changes of values; the second supply of higher doses produced a trend to a slight increase of labile iron only in one out of two rabbits.

2125 Concerning Individual Differences in the X-ray Sensitivity of Human Skin, Examined by the Appearance of an Erythema. Roderich Helmke. Strahlentherapie 80, 585-90(1949)(in German).

Fifty men and fifty women were treated through 10 fields on the back with x-ray dosages from 200-400 r, increasing by 25 r from field to field. Special attention was paid to the appearance of the early x-ray erythema and the main x-ray erythema. The early erythema field was the one which, while showing a well-defined red field, had received the smallest r-dose. The main erythema field was determined 15 days after irradiation. For the appearance of the early erythema there was an individual variation range of 100 r in men and women; for the main erythema, the variation range was 50 r in men and 75 r in women.

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2126 The Cytological Changes That Occur in the Anterior Pituitary Glands of Rats Injected with Various Doses of I^{131} and Their Significance in the Estimation of Thyroid Function. R. C. Goldberg and I. L. Chaikoff. Endocrinology 46, 91-104(1950) Jan.

A cytological study of the pituitaries of rats injected with 18, 300, 525, and 875 μc of I^{131} is presented. The injection of 18 μc of I^{131} resulted in no cytological changes in the anterior pituitary and is concluded to be a safe tracer dose. Evidence is presented to show that the changes occurring in the anterior pituitaries of rats after the injection of large amounts of I^{131} are not the result of radiation damage to the pituitary itself but solely the consequence of thyroid destruction. The injection of 300 μc of I^{131} resulted in considerable thyroid destruction, but 5 to 8 months later, normal glandular function was regained. From a study of the reaction in the anterior pituitary, it was shown that the atypical thyroids present 6 to 8 months after single injections of 525 μc of I^{131} synthesize negligible amounts of thyroxine or none at all. The cytological changes occurring in the anterior pituitary after the injection of 875 μc of I^{131} are concluded to be identical with those occurring after total surgical thyroidectomy. 18 references. (auth)

2127 Cytogenetical Effects of Internal Radiations from Radioisotopes. Norman H. Giles, Jr., and René A. Bolomey. In Cold Spring Harbor Symposia on Quantitative Biology, Vol. XIII, pp. 104-12. Cold Spring Harbor, L.I., N.Y., Biological Laboratory, 1948.

The results of a cytological analysis to determine the amount of change caused by radiations from isotopes in Tradescantia buds and microspore nuclei grown on radiophosphorus, P^{32}, media and in some cases C^{14} media are presented. The rates of uptake of P^{32} and C^{14}, the chromosomal rearrangements produced by the β radiation from these isotopes, and reliability of the available techniques are discussed. 14 references.

2128 Determination of X-ray Dosage by Polymerization Reactions. Annette Prévot. Compt. rend. 230, 288-90(1950) Jan. 16 (in French).

It has been found that x-rays initiate polymerization in acryolite (Nature 160, 268(1947)), methacrylate and methyl (Reichsber, Physik 1, 111(1944)). The behavior of other monomers has been studied and the degree of polymerization, measured by the volume change, is plotted, by the author, as a function of the irradiation time. These curves, obtained from samples irradiated under known conditions, may be used as standards to determine dosages. Because of the linearity of the polymerization curve, acrylonitrile is to be preferred in this work. For this monomer it was found that the amount of contraction is proportional to the irradiation time if the source intensity is constant, and to the square root of the intensity if the time is constant.

2129 Effects of Irradiating Maize Pollen in a Nuclear Reactor on the F_1 Plants. E. F. Frolik and Rosalind Morris. Science 111, 153-4(1950) Feb. 10 (Technical paper).

This paper constitutes a preliminary report on the inherited changes induced by irradiating maize pollen in a nuclear reactor. Mature maize tassels were placed in the thermal neutron column of the Argonne pile, which was

operated at a power in the neighborhood of 300 kv. The average flux of neutrons at the position of the tassels was 7×10^{10} neutrons/cm^2/sec, and the exposure times varied from 0-16 min. Crosses were made by collecting pollen from the tassels and placing it on the untreated female plants. The seeds were then planted and the percentage stands of the different seed groups is tabulated. Other effects of the irradiation, such as the types of abnormalities produced, are described in the article.

2130 The Effect of X-irradiation on Tissue Rhodanate. M. C. Bowman and W. R. Franks. Acta Unio Intern. contra Cancrum 6, 765-7(1949).

The results of investigations to determine whether the destruction of tissue rhodanate by x-irradiation is accompanied by disturbances in the Pasteur reaction of the tissue are reported. The bodies of mice under light Nembutal anesthesia were covered with lead shields, only the heads receiving x-ray surface dosages of 10,000 r (base dosages of 7,000 r); the radiations were delivered by a 88-kv source with no filtration, at a distance of 10 cm over a period of 10 min. The irradiated animals were sacrificed at various intervals and estimations of the rhodanate activity, respiration, anaerobic and aerobic glycolysis of their grey brain matter were carried out. The rhodanate activity was determined by a slightly modified Lang method, which is described here. It was found that the Nembutal did not affect either the rhodanate activity or the respiration and glycolysis of the mouse brain grey matter; the x-irradiation did not inhibit the rhodanate activity in rat liver homogenate in vitro, but was lethal to the mice in 8 to 10 days. Summarizing, no significant activity changes in the rhodanate, respiration or glycolysis were detected.

2131 Effects of Repeated X-radiation of the Whole Body on the Development of Tumors in Rats Due to Feeding p-Dimethylaminoazobenzene. Cornelia Hoch-Ligeti. Brit. J. Cancer 3, 562-9(1949) Dec.

Forty male and 10 female Wistar rats were fed ad lib a semi-synthetic diet, containing 0.07% p-dimethylaminoazobenzene, and 20 of the male rats were given soft x-radiations, while 10 male and 10 female rats received penetrating x-radiations. The irradiations were begun on the same day as the feeding of the carcinogenic compound and similar techniques of application were utilized. The penetrating radiations were delivered by a 180-kv machine with a 0.75 mm Cu and 1 mm Al filtration at a focal distance of 30 cm, while the soft radiations were delivered at 45 kv with no added filtration and at a focal distance of 20 cm. At the beginning of the experiment, each rat received 10 r once weekly, delivered to the liver as a 10 r dose in the case of the penetrating radiations (with a dorsal skin dose of 13 r), and as a dose of 0.3 r to the liver for the soft radiations. Each rat was irradiated individually and the intervals between irradiations were extended to two weeks and occasionally three to four weeks. The rats treated with hard radiations received a total of 310 r in the liver, while the soft radiation group received a total of 10 r. All nonirradiated rats receiving p-dimethylaminoazobenzene developed hepatic tumors, but the development of tumors was prevented, or their rate of growth retarded, in rats treated with soft radiation. The growth of hepatic tumors was slightly retarded in rats treated with penetrating rays and skin tumors developed in two of these rats. The adrenals of rats receiving soft x-rays were significantly enlarged.

2132 The Effect of X-ray Irradiation on the Pituitary Body of Infantile Rats Treated with α-Estradiol Monobenzoate. A. Baidins, L. Claesson, and A. Westman. Acta Endocrinologica 1, 133-40(1948).

Fourteen female rats were treated with a total of 160 μg of α-estradiol benzoate subcutaneously, over a period of 8 days and then irradiated with 40 r in a single exposure over the pituitary region with the rest of the body shielded with lead; 7 rats were similarly treated with estradiol and 4 others served as untreated controls; all the animals were observed for 50 days after treatment. Those injected with estradiol benzoate all had canalization of the vaginal orifice and developed cornified vaginal smears which disappeared after the conclusion of the estradiol treatment and again reappeared at the expected time for puberty; the cycles subsequent to puberty were unaffected except in 3 irradiated rodents. All rats were autopsied 58 days after the first injection (51 days after irradiation) at an age of 66 days and the pituitaries were weighed and sectioned. No significant differences could be observed in the microscopic appearance of the pituitaries in the various groups; the ovaries of the estradiol-treated controls weighed the same as those of the untreated animals, but in the former there were fewer follicles and several large vascular corpora lutea. The estrogen-treated, irradiated rats, however, showed a considerable difference from the estrogen-treated nonirradiated animals, in that the ovarian weights were significantly higher (an increase of approximately 50%) and the follicles showed marked degeneration; however, a well-developed interstitial gland was found, but corpora lutea were entirely absent in 5 out of 14 animals so treated. It is concluded that under the influence of estrogen, the pituitary of the infantile rat is sensitive to radiation doses (1 to 1,000 r) which fail to affect normal infantile rats.

2133 Epilation in the Non-Irradiated Member of Parabiotically United Rats. Donald C. Van Dyke and Rex L. Huff. Proc. Soc. Exptl. Biol. Med. 72, 266-9 (1949) Oct.

An experiment was performed to determine the magnitude of the protection from x-irradiation afforded rats in parabiosis. Three groups of 20- to 30-day female rats of the Slonaker strain (almost completely homozygous genetically) were used. Both parabiotic twins from group one were irradiated; the second group contained parabiotic twins which were not irradiated and which served as controls; the third group contained a number of single animals irradiated in the same manner as the parabiotic twins in group one. A 200-kv machine was used with 0.5 mm Cu and 1.0 mm Al filtration at a delivery rate of 40 r/min and at a target distance of 37.5 cm. The members from groups one and three were then irradiated alternately on the same day; one animal of each parabiotic pair from group one received 27 r, while the other received 900; then two single animals from group three were irradiated, one receiving 27 r and the other 900 r. For the most part the control animals and the single animals from group three which were irradiated with 27 r showed no radiation injury; however, both members of the parabiotic pairs

in group one started to lose their hair about 4 weeks following the irradiation, the protected members (those receiving only 27 r) being affected to a greater degree but for a shorter period of time than the unprotected members (those receiving 900 r). The single animals in group three receiving 900 r died within a week after the irradiation. It has not been determined whether the epilation in the less irradiated member of the parabiotic twins represents the transfer of some physiologically active material from the more irradiated to the less irradiated member or the loss of material in the more irradiated member, and subsequent transfer from the less irradiated member.

2134 Epithelioma and Papilloma Arising on Recently Irradiated Skin; Report of Three Cases. J. Walter. Brit. Med. J. No. 4648, 273-4(1950) Feb. 4.

A series of three cases of epithelioma and papilloma developing a few months after x-ray reactions of only moderate severity is presented and the cases are discussed in detail. In the first case, the total treatment time was 31 days and the estimated tumor dose was 4,600 r; the skin reaction proceeded to a deep erythema with dry desquamation and a few small and moist patches. Healing was rapid and uneventful but about 14 weeks after the end of the treatments, a nodule developed on the irradiation site which was excised and concluded to be a papilloma; the patient is well to date. About 11 weeks after the delivery of a skin dose of 3,900 r to the second patient, with consequent erythema of moderate depth, a nodule identified as squamous epithelioma developed and one year after excision the patient died from the effects of the primary lesion (carcinoma of the hypopharynx). A total dose of about 3,500 r was delivered to the third patient over a period of 23 days with a moderate erythema developing; seven weeks after the end of the treatments a nodule developed in the irradiation site which was identified as being squamous epithelioma; irradiation for a total of 3,500 r was then delivered in 23 days, and the patient is well to date. Several explanations of the occurrence of these secondary lesions are presented.

2135 Experiments Relating the Antiphlogistic Effect of X-rays. B. Wald and V. Varteresz. Radiologia Clin. 17, 348-62(1948) Nov.

In the experiments described, sodium chloride swellings were produced in humans irradiated with doses of 100 to 6,6,500 r in order to determine the functional changes brought about in the capillary endothelium by x-radiations. It was found that the anti-inflammation effect of x-rays was due to a reversible temporary paralysis of the capillary endothelium, thereby preventing exudation. X-ray therapy of most allergic inflammations and of some cases of acute nonallergic inflammations is suggested; the irradiation technique in such cases should consist of irradiation at 5- to 6-day intervals, since the x-ray effects on the endothelium recede in about that length of time.

2136 Fetal Tolerance to Roentgen Rays. A Case Report. Arthur A. Hobbs, Jr. Radiology 54, 242-6(1950) Feb.

A pregnant woman, found to have adenocarcinoma of the breast, and operated upon, was later shown to have an osteolytic lesion in the sacrum and right ilium. Upon refusal to allow surgical interruption of the pregnancy, she was irradiated with a total dose of 1,500 r measured in air, the beams being directed dorsoventrally and ventrodorsally, so as to produce a calculated dose of 900 r at the mid-pelvic region; additional radiation was later directed to the dorsal field, adding 375 r to the dose at the center of the pelvis. Pregnancy was terminated with delivery a month later and soon thereafter the osteolytic lesion healed, but the patient died about six months later of liver metastases. The child has appeared to be normal ever since birth. It is stated that the circumstances and irradiation factors in this case parallel the requirements listed by Harris and Mayer for the accomplishment of spontaneous abortion, and no adequate explanation can be offered for the noneffectiveness of the x-irradiation, but it is concluded that the fetal age was apparently a modifying factor.

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2137 Further Studies on the Relation Between Radiation Effects, Cell Viability, and Induced Resistance to Malignant Growth. VI. Anomalous Radiosensitivities of Analogous Mouse Mammary Adenocarcinomas. Anna Goldfeder. Radiology 54, 93-114(1950) Jan.

Experiments designed to investigate tumors grown in inbred strains of animals, autogenous to the respective strains, with respect to their radiosensitivity and their immunizing properties are presented. It was found that mammary adenocarcinoma grown in dba and C3H mice differ in their rate of growth, metabolic activity and radiosensitivity in the proportion of about 1 to 3; the faster growing tumor, dbrB of the dba strain, was proved to require a larger dose of irradiation (up to 24,000 r) when grown in hosts of origin, while the slower growing mammary tumor of the C3H strain required only 12,000 r. It also appears that the strongest effect of irradiation is exerted on the least differentiated cells when irradiated in vitro, but this is not true in vivo. It is concluded that follow-up treatments within the five-year period after cancer therapy may be necessary to prevent recurrences of the diseases.

2138 A Histopathologic Study of Radiation Injuries of the Skin. H. A. Teloh, M. L. Mason, and M. C. Wheelock. Surg. Gynecol. Obstet. 90, 335-48(1950) March.

The history of irradiation injuries of the skin is briefly summarized and clinical aspects of irradiation dermatitis, acute and chronic, are reviewed. Of 121 patients with radiation dermatitis, as a result of the use of x-rays, radium, and radon, 28.1% showed definite evidence of carcinoma, usually localized by the stromal barrier. Such epidermal changes as atrophy of epithelium with the consequent loss of rete pegs, alternating with focal areas of hypertrophy, characterized by marked acanthosis, hyperkeratosis, and rarely parakeratosis, were seen. The vascular picture consisted of marked endothelial proliferation with narrowing or occlusion of the lumen of the artery, fibrosis and hyalinization of the media, fibrosis of the adventitia and occasionally perivasive edema and lymphocytic infiltration. Stromal changes, and changes in hair follicles, sebaceous glands and sweat glands are also described. It is noted that in the 121 cases studied vascular changes were the most constant, the earliest and the most pronounced of the changes observed in the skin. Evidence is presented on the direct carcinogenic effect of irradiation on the epidermal portion of the skin. It

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is concluded that the therapy of a benign cutaneous or subcutaneous lesion by means of irradiation, with the potential production of a much more severe irradiation dermatitis, is not justified unless it can be carried out by a roentgenologist trained in the limitations and potentialities of such therapy. 35 references.

2139 Histopathological Changes Induced in the Normal Thyroid and Other Tissues of the Rat by Internal Radiation with Various Doses of Radioactive Iodine. R. C. Goldberg, I. L. Chaikoff, Stuart Lindsay, and D. D. Feller. Endocrinology 46, 72-90(1950) Jan.

Rats of the Long-Evans strain were given single intraperitoneal injections of 18, 300, 525, or 875 μc of I^{131}. Autopsies were performed at intervals of 3 days, and 1, 5, 6, and 8 months after the injection. No evidence of damage to any tissue was observed as early as 12 to 24 hr after injection in the thyroid glands of animals receiving 300 or 525 μc of the isotope. The process consisted of five stages: degeneration and necrosis of epithelial cells with follicular disruption; vascular degeneration and thrombosis; acute and chronic inflammatory changes; fibrous organization; and, epithelial regeneration. The thyroids of rats subjected to 875 μc of the isotope responded in a similar fashion, except that no epithelial regeneration occurred; regeneration to normal thyroid structure was found in the animals which had received 300 μc of I^{131}, but atypical thyroid cells (resembling Hurthle cells) were present 5 to 8 months after the 525 μc administration. Viable-appearing parathyroid glands were demonstrated in all the injected animals, with some fibrosis appearing only in the higher isotope concentration groups. Evidence of tracheal damage, and slight reversible changes in the kidneys were noted; normal livers were demonstrated. 14 references. (auth)

2140 Irradiation of Mixed Tissues. W. H. Love. Nature 165, 227-8(1950) Feb. 11.

If a tissue of given type is acted upon by radiation of a given quality, it is known that the fractional survival P, associated with a dose q, is determined by $fn(\lambda q)$, the first $n + 1$ terms of the Poisson series in λq, where n and λ are characteristic of the tissue and the quality of the radiation. If the fractional survival is plotted against dosage for two different tissues, the author shows that the curves will cross for certain values of n and λ. This fact may lead to erroneous conclusions as to the relative sensitivities of the tissues to radiation.

2141 The Question of X-ray Atrophy of the Testes. Eberhard Günsel. Strahlentherapie 80, 467-74 (1949)(in German).

It was demonstrated in experiments that the thermolabile testes of rats, if exposed to hot water baths of 40 to 45°C, developed the same atrophy as observed after radiation treatment with high dosages. The so-called "x-ray testes" are concluded to be a problem of dosage only. After small injuries, the effects on the testis cells parallel the stage of maturity of the cells, beginning with the mature spermatozoa; following more extensive injuries, the epithelial layers are injured and loosened in the order of their position toward the lumen of the canals, or they all may be loosened simultaneously.

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2142 Radiobiological Additivity of Various Ionizing Radiations. Raymond E. Zirkle. Am. J. Roentgenol. Radium Therapy 63, 170-175(1950) Feb.

A discussion is presented on the problem of additivity of various types of ionizing radiations. A summary is included which outlines the degree of additivity found in various experiments by the author and others through combinations of α, β, γ, fast-neutron and x-rays on the mouse, bean roots, Drosophila eggs, Drosphila pupea and the human skin. It is concluded from the analysis of these studies that incomplete additivity of two types of radiation indicates some difference in the mechanism of action of the radiations. Complete additivity indicates that the mechanisms of action of the radiations are identical in their most essential feature, the promotion of the same determinative events (one of a succession of unknown relevant events leading to the production of the known biological effect), but are not necessarily alike otherwise. It is concluded that it is probably wise to assume that additivity of fast neutrons and γ rays is the complete type.

2143 Sulfocyanate, Tocopherol and X-rays. A. Hervé and Z. M. Bacq. Compt. rend. soc. biol. 143, 1158-9(1949) Aug. (in French).

In the present report the authors offer an interpretation of the protective action of cyanide against the effects of strong whole-body irradiation in mice. The protective action was not demonstrated by sodium sulfocyanate, and the authors have searched for other substances which would inhibit the lethal effect of x-radiations, but which would be less toxic than the cyanide, an inhibitor of metabolism. The authors suggest that the cyanide acts either by hindering the formation of the peroxides or by diminishing the reaction of formed peroxides with reducing groups such as the −Sh group. This hypothesis was tested by using vitamin E (α tocopherol), an excellent inhibitor of peroxide formation by the action of x-rays on lipids. It was found that the mice withstood the dose of x-rays administered (400 r) much better (30% mortality to 60% mortality) than mice not treated with two 10-mg intravenous injections of the α tocopherol at 24-hr intervals before the irradiation. It is concluded that the protection by cyanide against the effects of x-rays in mice is due to the action of the CN-ion; the protection is limited in the sense that it is weak if the dose of x-rays is increased, and is very weak if the injection is made as late as 15 min after irradiation.

2144 Tentative Dose Units for Mixed Radiations. H. M. Parker. Radiology 54, 257-62(1950) Feb.

This report discusses dosage units for mixed radiations and concludes that the energy absorption dose in irradiated tissue should be stated in ergs/g in scientific reports. In therapeutic and other practical applications, the use of a practical unit, the rep (roentgen equivalent physical), an energy absorption dose of 93 ergs/g, allows a reasonable transition from previous experience in dosage statements in roentgens. It is claimed that under simplifying conditions the combined effect of mixed radiations can be evaluated in a common unit, the rem (roentgen equivalent man—or mammal); this method incorporates a factor for the relative biological effectiveness in the physical statement of the dose in rep of each radiation type. Such a device is concluded to

be necessary for the management of exposures of personnel to mixed radiations, and may be useful ultimately in mixed radiation therapy, when the physical dose is more precisely stated and knowledge of biological effectiveness factors is improved. (auth)

2145 Theoretical and Experimental Investigations of Cell Membrane Permeability. Ladislaus Neu. Strahlentherapie 79, 141-63(1949)(in German).

By applying the laws of classical mechanics, the author attempts to explain and coordinate certain features of cell membrane permeability, such as its periodicity and its change under the influence of radiation. It is found that the membrane permeability can be considered a phenomenon which is propagated through the organism in wave form, the phase velocity of the wave being of the order of magnitude of the velocity of conduction of nerve impulses. This leads to the assumption that the medium in which the waves are propagated is the nervous system. Special attention is paid to the changes of cell membrane permeability after irradiation with x-rays, and to the periodicity of biological radiation effects in general.

2146 Radioactive Waste Disposal. John A. Ayres. AECD-2802, nd, Decl. Jan. 31, 1950. 25p.

In laboratories using radioactive tracers a large amount of liquid wastes having a low level of activity will be produced. In many cases it may be desirable to treat these wastes before they are discharged into the sewers or released in any other manner into the ground or water. Ion exchange is applicable to problems of this sort in that it may be used for the removal of small amounts of ions from very dilute solutions. The problem of removal of radioactive solids from laboratory wastes is complicated by the fact that the wastes are heterogeneous and vary from day to day. The wastes will contain solids, organic solvents, oils, and reagents which may form complexes with metallic ions. The research program to evaluate ion exchange has been divided into several parts, namely: (1) the efficiency of ion exchange resins for this type of process; (2) determination of operating curves under set conditions for typical types of ions; (3) determination of amount of leakage or efficiency of ion exchange resin in order to estimate decontamination factors; (4) effect of reagents which might cause precipitation or complexing; (5) effect of solvents, greases, detergents, or precipitates; (6) possible concentration by incineration. Two procedures, complete de-ionization and partial de-ionization, are described. Experimental evidence was obtained to show: (a) a high decontamination factor may be obtained using synthetic solutions which represent laboratory conditions; (b) a high concentration factor may be obtained making possible the compacting of the wastes into small volumes; (c) the presence of ordinary contaminants such as oils, solvents, and precipitates do not have a great deleterious effect.

2147 Personnel Protection in the Use of Radioactive Isotopes. G. Failla. J. Clin. Invest. 28, pt. 1, 1281-5 (1949) Nov.

Some factors to be considered by personnel working with radioactive isotopes are presented. Among the factors stressed are the importance of maintaining constant and

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accurate monitoring of the possible areas of contamination; the mental attitude of the worker is important in that it determines the manner and method in which the worker makes use of the available precautionary measures and devices. The proper kind of measuring instrument known by actual test to be in good working order, and adequate isolation of the radioisotopes to prevent possible scattered radiation are essential; a β-ray source (such as P^{32}) is concluded to be especially dangerous because of a greater possibility of radiation scattering. The long-range effects of overexposure from the radioisotopes are not in most cases immediately discernible, often mainifesting themselves long after corrective measures can be taken; cancer, irreparable injury and death may occur. A table is included which presents the dosage rates at different perpendicular distances from the surfaces of two radioactive preparations. Other topics are briefly discussed and mention is made of the revised permissible limits of exposure to ionizing radiations; whole body exposure to x-rays or γ rays of up to 3,000,000 v is 0.3 r/week, measured in air; local exposure limited to the hands is 1.5 r/week or 1.5 rep for β-ray exposure, measured at the basal layer of the epidermis.

2148 Pulmonary Cancer Produced by Radioactive Emanations. M. S. Vesin. Arch. maladies profess. méd. travail et sécurité sociale 9, 280-3(1948)(in French).

A discussion is presented on the effects of radioactive emanations on the lungs of mine workers in Jachymow. It is claimed that other predisposing factors toward the development of carcinoma of the lungs in miners are the lack of oxygen, the excess of carbon dioxide, and, possibly, silicosis and arsenic dust. Prophylaxis requires better ventilation of the mines; work in the mines, it is concluded, should be restricted to 5 to 10 years per person.

2149 The Acute Radiation Syndrome in Man. Shields Warren and John Z. Bowers. Ann. Internal Med. 32, 207-16(1950) Feb.

The pathogenesis, histopathology, symptomatology, clinical course, laboratory findings, complications, sequelae, therapy and prognosis of the acute radiation syndrome in man are discussed. Tables are included which demonstrate the variation in the sensitivity of the tissues of the human body to ionizing radiations and variations in sensitivity between species; such concepts of the mechanism of the effects of radiation on the body as the cell hydration theory and the target theory are outlined. Cellular, stromal and vascular effects of the radiation are noted, and the prominent manifestations of the syndrome (asthenia, diarrhea, nausea and vomiting, mucosal ulcerations, epilation, fever, and tachycardia are correlated with three types of radiation illness seen: the fulminating form (most severe), the hemorrhagic form, and the pancytopenic form; hematological responses and bacterial infections are discussed along with such sequelae as possible mutation effects and neoplasia. It is stated that the treatment of individuals exposed to damaging amounts of ionizing radiation is at this date supportive and nonspecific, there being no known specific agent which will ameliorate the injury. Such agents as folic acid, toluidine blue, rutin, protamine, adrenal cortical extract and parenteral therapy (for the correction of aberrations in blood electrolytes) are mentioned. Patients who develop the fulminating course of the

radiation syndrome are concluded to have lethal amounts of radiation. However, those patients exhibiting the hemorrhagic and pancytopenic forms, with consequent delayed radiation effects, are said to have received either lethal amounts or sublethal amounts and a certain proportion can be expected to survive. 33 references.

2150 On Irradiation Sickness. K. Setälä and P. Ermala. Annales Chirurg. Gynaecol. Fenniae 37, Suppl. 1, 1-59(1948).

The relationship between irradiation sickness and mobile visible blood lipids is discussed in this report based on 65 cases. The cases uniformly demonstrated a marked decrease in the chylomicron count during radiation sickness, which was not present in irradiated cases not developing the sickness; the degree of sickness was proportional to the degree of depression in the count. Irradiation in excess of 350 r over the abdomen, pelvis, and the bifurcation of the common carotid produced radiation sickness with changes in chylomicron count, while corresponding irradiation over extremities produced no sickness or changes in count. The administration of histamine acid phosphate caused changes in chylomicron counts similar to those found in radiation sickness. The authors suggest that their work corroborates that of others who found that irradiation liberates a "histamine-like substance" (not in all effects similar to histamine, and unresponsive to antihistaminics); paraganglionic elements may be affected either directly by the irradiation or by a toxin resulting from irradiation.

2151 Radiation Sickness. W. Warner Watkins. Arizona Med. 7, 17-21((1950) Feb.

A general article is presented which describes the changes in radiation techniques of various diseases and in the consequent incidence of radiation illness from 1900 to the present day. The author observes that the clinical and pathological aspects of all types of ionizing radiations duplicate those produced by x-rays (frequently seen). Knowledge of the effects of radiation and the available methods to combat them should be the aim of the present-day doctor.

2152 Treatment of Leucopenia Due to Irradiation with Vitamin B_6. F. Rovello and L. Ferri. Haematologica 32, 319-32(1948)(in Italian).

In ten patients treated with roentgen rays for different types of tumors, the decrease in the number of leucocytes was controlled by the administration of pyridoxine (vitamine B_6), 100 mg daily.

2153 Radiography with Beta-Rays. Torbjörn Westermark. Nature 164, 1086-7(1949) Dec. 24 (Letter to the editor).

Several β sources have been used to study specimens of various thicknesses. Beta radiographs have been produced by three methods. The most satisfactory results were obtained by concentrating the β source on to a small area and placing the specimen, lying directly on the photographic emulsion, at about 5 to 10 cm from the source. Thus an almost parallel pencil of rays is used. The other two methods involve the use of extended sources, either in contact with the specimen, or at a short distance from the specimen. The direct contact method is the fastest but does not give

as good resolution as the other two. The main advantages of the method of β radiography are the simplicity and low cost of the equipment required.

2154 The Significance of X-Ray Spectrography for Medical Science. W. Bufe. Strahlentherapie 78, 625-38 (1949)(in German).

The usefulness of x-ray spectrography for medical science is stressed and shown in normal and pathological conditions of the bone. Whereas the resolving power of the ultramicroscope reaches only 0.005 μ or 10^{-5}, with x-ray spectrography structures down to a limit of 10^{-8} can be studied. The three main methods are: (1) that of Laue, resting crystal and heterogeneous x-ray irradiation; (2) method with rotating crystal and homogeneous irradiation; and (3) method of Debye, Scherrer, and Hull, many crystals and homogeneous irradiation. Among the problems successfully investigated are: the age diagnosis of the bone tissue, the precipitation of Ca salts and ossification, bone fractures and formation of calluses and changes in the bones in rachitic conditions. The author introduces the term "leptopathology" to describe the investigation of pathogenic disturbances involving molecules, atoms, electrons, and protons. 45 references.

2155 Cancer of the Body of the Uterus. N. Pescatore. Oncologia 22, 419-28(1948)(in Italian).

The incidence of cancer of the body of the uterus is discussed with regard to age, constitution, heredity, social conditions, sexual activity, diathetic and inflammatory factors, general disease, fibroids, and trauma. The pathogenesis is still unsolved. The morbid anatomy, symptomatology, diagnosis, and treatment (radiological and surgical) are described.

2156 Cancer of the Lip. J. Ernest Breed. Mississippi Valley Med. J. 71, 193-5(1949) Nov.

The methods of treatment of cancer of the lip are discussed. The author's method consists of short daily treatments with a powderful radium or radon applicator over a period of about three weeks; three radon tubes laid side by side in the applicator comprising a total of 500 mc of radon, with a screening of 2 mm of Ag are utilized. The three surfaces of the lip are treated in rotation and until a minimum of 5,000 r is delivered. It is claimed that early cancer can as a rule be completely eradicated if the treatments are carefully done, and inoperable moderately advanced cases can either be controlled or reduced to an operable state. The author states that the radium treatment of metastatic nodes is, however, not very successful. Sharp block dissection of palpable nodes is advocated but routine operation for all cases is advised against.

2157 Carcinoma of the Cervix (University Hospitals, 1926-1942). J. H. Randall, W. C. Keettel, H. C. Willumsen, and J. W. Scott. Am. J. Obstet. Gynecol. 59, 285-95(1950) Feb.

The results of the treatment of 978 cases of cervical carcinoma by irradiation therapy at the State University of Iowa Hospitals are presented. From 1926-1931, patients were treated by one or more applications of radium, followed by short courses of deep x-ray therapy, and in 1931, the plan of therapy was changed so that a course of deep x-ray therapy was given to the pelvis and was followed in a few weeks by

radium applications to the local lesion. From 1937 on, the present method was instituted, and consists of a course of deep x-ray therapy to the pelvis through six to eight skin portals; the radiations are delivered at 200 kv at a target distance of 50 cm and through a filter of 2 mm Cu in doses of 200 r to each port; the total dosage is 10,000-25,000 r. Late in the x-radiation course or at its conclusion, radium therapy is applied locally. Two 25.0 mg tubes screened with 1.5 mm of platinum and 1.0 mm of rubber are placed in tandem into the uterine cavity and six 10.0 mg tubes screened with 1.5 mm of platinum are placed against the cervix; 5,500-6,500 mg hr are delivered. Irradiation sickness has been empirically treated by oral administration of viosterol or sodium chloride or by large parenteral doses of thiamine, vitamin B complex, or pyridoxin hydrochloride. An absolute five-year survival rate of 30.4% has been obtained, and marked improvement in the end results have been attributed to improvement in the irradiation technique over the years. There has been a definite primary mortality of 1 to 2% in these cases, due to irradiation to the point of tissue tolerance.

2158 396 Cases of Simple Goiter in Biella Treated with Radiotherapy. E. Benassi. Minerva med. 2, 351-7 (1948)(in Italian).

The author irradiated 396 cases of benign simple goiter (with no signs of hyperthyroidism or dysthyroidism), consisting mostly of diffuse parenchymatous forms, chiefly of the hyperplastic juvenile type. Doses of 150 - 180 r/session were delivered alternately to two laryngeal fields for six to eight daily sessions; a total of three courses of therapy were given at monthly intervals. The results obtained were generally good, and frequently excellent; the majority of the cases showed a definite reduction or disappearance of the goiter, but the best results were obtained in the hyperplastic juvenile type, especially in recent cases. The author advocates the application of radiotherapy to simple benign goiters as early as possible.

2159 Changes in the Prothrombin Level in Women with Cancer Treated by Irradiation. E. Soyková-Pachnerová and O. Soyka. Casopis Lekaru Ceskych 88, 169-71(1949)(in Czech).

Checking up on reports in the literature of prothrombin-level changes after x-ray and radium therapy, the authors examined 65 women with ovarian and uterine cancer by the Quick test at the first treatment, three months after it, and at the second treatment. They found the prothrombin-level to be less affected by the treatment than by the patients' general condition. A prothrombin-level which does not change during treatment is claimed to be indicative of a favorable prognosis, whereas in cases where there is a change, the bigger the change the worse the prognosis; whether the change is upward or downward is claimed to be unimportant.

2160 Chronic Respiratory Diseases in Infants and Children. Value of Roentgen-Ray Therapy. W. Price Killingsworth and Fred Y. Kuhlman. Texas State J. Med. 46, 92-7(1950) Feb.

The results of the treatment of 341 cases of cervical adenitis, chronic tonsillitis and adenoiditis, chronic nonspecific bronchitis, allergic bronchitis and chronic sinusitis in children by x-ray therapy are presented; the authors applied the radiation therapy in those cases where sulfonamides and antibiotics failed. Doses of 100-150 r were delivered at 140 kv through a filtration of 0.25 mm Cu and 2 mm Al at a target distance of 50 cm; the allergic and chronic bronchitis cases received three to six doses at 5- to 7-day intervals. The best results were obtained in infants and children with low-grade fever and elevated leukocyte counts. Since 79% of the total number of cases showed improvement, the author concludes that roentgen therapy seems to be particularly indicated for children with chronic respiratory conditions of the types described here. 16 references.

2161 Clinical Radiation Therapy. Ernest A. Pohle, Ed. Philadelphia, Lea and Febiger, 1950. 902p.

This book discusses various types of radiation therapy used in the treatment of diseases of the blood and hematopoietic organs, the circulatory system, respiratory system and the breast, gastro-intestinal tract, female genital organs, genito-urinary tract, nervous system, eyes and ear, muscles, bones, joints and tendons, glands of internal secretion, skin and inflammatory diseases in separate sections presented by a variety of clinical investigators. Radiation reactions and injuries, and the civil liability of the radiologist are also commented upon. Two supplements are added and discuss low intensity radium needles and dosage calculation in radium therapy. An index is included and a bibliography appears at the end of each topic considered.

2162 Concerning the Significance of Lymph Gland Puncture in Irradiation Therapy. Werner Lorenz. Strahlentherapie 73, 435-64(1949)(in German).

The great diagnostic value of lymph gland puncture is illustrated in a number of cases where it was possible to diagnose a sarcoma or carcinoma solely from the cell material found after puncture. Qualitative or quantitative particularities of the cell material may indicate the sensitivity toward irradiation. In cases of lymphogranulomatosis it seemed possible to determine the sensitivity toward irradiation by the state of maturity of the cell elements. Young cells, with minimal differentiation elements, were more sensitive than such cells as the polynuclear giant cells. Consequently it seemed that tumors composed of younger cells elements could be treated with smaller r-dosages than tumors composed of a more mature cell type. Lymphosarcoma, of the great cell type, was more sensitive toward irradiation than that of a small cell type. 19 references.

2163 Concerning X-ray Therapy of Illnesses of the Peripheral Nerves. Klaus Decker. Strahlentherapie 80, 419-26(1949)(in German).

Thirty patients with neuralgia of the trigeminal nerve, six patients with occipital neuralgia, one patient suffering from coccygodynia, and six patients with neuralgia after trauma were x-ray treated. The radiations were delivered by a 180-kv machine, with a 0.5 mm Cu filter, at a focal-skin-distance of 40 cm. The dosage was different for each patient and varied in the cases of neuralgia of the trigeminus from 750 to 1450 r, with a successful outcome in 75% of the cases. The patients with occipital neuralgia received a total dosage of 1,000 to 2,250 r in 6 to 12 sittings; all patients in this group reacted well to this therapy. One patient with coccygodynia was

treated through two fields, starting with 50 r and increasing the doses to 200 r until the total dosage was 2,350 r; the therapy was successful. Results in patients with neuralgia after trauma who received a total dosage of 3,200 to 4,200 r were not very promising; nevertheless, the author concludes, x-ray therapy in these illnesses is very much to be recommended. 31 references.

2164 Contribution to the X-ray Therapy of Esophageal Carcinoma. R. Haubrich. Strahlentherapie 80, 559-68(1949)(in German).

Thirty-two cases of esophageal carcinoma were treated with x-rays delivered by a 195-kv machine, with a 0.5 mm Cu and 1.0 mm Al filter in fractionated long-interval doses (usually over periods of 6 weeks); the total dosage was 3,000 to 4,500 r, but no 3- or 5-year cures could be achieved. Total dosages under 3,000 r had no effect on the life span (8 months) of the treated patients; with dosages over 4,500 r, though, the life expectation increased to an average of 10.7 months. The author observes that it does not make any difference in the life expectancy whether the patient is treated early or late, but a small tumor has a greater chance of being completely destroyed, and the high dosages necessary can be applied only if the general condition of a patient is still good. The site of the tumor or the grade of the stenosis are of no great importance in themselves, but by opening the stenosis, an opportunity is provided for longer survival. 22 references.

2165 Diagnostic Radioactive Iodine Test in Hyperthyroidism. B. Skanse. Nord. Med. 37, 372-5(1948)(in Swedish).

Isotopic iodine, I^{131}, (0.1 mg of total iodine) was given to 25 untreated patients with hyperthyroidism and 15 normal subjects. It was excreted in the urine 6 to 48 hr after administration. Thyrotoxic patients retained 68 to 94% and normal subjects 16 to 47% of the isotope. This method is concluded to be of practical diagnostic value.

2166 Dosage of High Voltage Radiation within Bone and Its Possible Significance for Radiation Therapy. C. W. Wilson. Brit. J. Radiology 23, 92-100(1950) Feb.

An attempt was made to study some of the processes whereby energy is absorbed in bone and soft tissue from high-voltage (x and γ) radiation. For this purpose calculations were made of the number and the ranges of the electrons generated, and of the partition of energy between photo- and recoil-electrons, in bone, soft tissue (muscle), and fat. From a brief consideration of the absorption of energy in the Haversian canals and other soft tissue elements present in bone, it is concluded that in the radiation treatment of bone tumors, concluded that in the radiation treatment of bone tumors, intracranial tumors and carcinoma of the cervix, it may be preferable to use very hard radiations (radium γ rays or x rays generated at potentials greater than 1,000,000 v). In the first case this is in order to produce minimal bone damage so as to permit maximal natural repair, and in the other cases to minimize radionecrosis of the calvarium and weight-supporting bones in the pelvis. The results show that the presence of tissue such as bone gives rise, in x-ray therapy, to local regions where extremely rapid energy absorption gradients exist. (auth)

2167 Doubtful Malignant Changes in the Endometrial Epithelium. A Report on 60 Cases from the Radiumhemmet. G. Marrubini. Acta Radiol. 31, 65-84 (1949).

Among a total of 1,014 cases of cancer of the uterine body, 60 grouped as "debatable cases" which are highly suspicious but not characteristic of malignant change are considered here. These cases were treated with radium in doses usually used for uterine cancer. In spite of this radical treatment adenocarcinomas developed in six cases, five being in the endometrium and one in the fallopian tube. A detailed description is given of the histological and clinical features.

2168 Expansion of Radium Therapy of Cervical Carcinoma through Interstitial Placing of Radium. Carl Fried. Radiologia Clin. 17, 333-47(1948) Nov.(in German).

The author advocates the interstitial needle technique of radium application in certain cases of carcinoma of the cervix, such as when cauliflower-like growths are present or infiltrating carcinomas, which narrow or obdurate the canal to such a degree that passage of radium tubes is impossible; several cases are included and described in detail. Carcinomas in stages three and four, which form a crater of the vaginal vault too large to be completely covered by a reasonable amount of radium in contact, are also treated by the needle technique and total doses of about 1,500 mg hr are delivered by 25 to 50 mg of radium present in 2 to 5 mg needles, over 10- to 18-day periods. After partial destruction and reduction of the growths to a size suitable for radium contact therapy, the latter method is used to complete the treatment. No undesired consequences have been observed, and delicate and durable vaginal scars have been formed. The author believes that it is well worth while to continue the use of interstitial radium technique in special cases. (auth)

2169 General Radiotherapy, Light, Roentgentherapy, Radium. Otto Jüngling. Stuttgart, Ferdinand Enke, 1949. (in German).

After a brief summary of the physical basis of radiation energy of the whole spectrum, a main section of the book discusses the various effects of light radiations on the human organism; ultraviolet and infrared light radiations are dealt with. The treatment of bone and joint tuberculosis by varying the climatic environment of the individual and utilizing natural and artificially produced light as adjuncts is described. The second part of this book deals with x-ray and radium therapy; the nature, measurement, and dosages in therapy with these agents are discussed; biological effects on cells, blood and organs of the body are pointed out. The treatment of carcinoma by radiation therapy and by surgery or a combination of both is described; palliative radiation therapy, and pre- and post-operative radiation therapy are also mentioned. The final chapters discuss the various dose effects on the blood and lymphatic system, the heart, the glands and the nervous system.

2170 Graves' Disease and Roentgen Therapy (Clinical and Case Contributions). G. Mergoni and I. Orlandini. Giorn. clin. med. (Parma) 29, 795-855 (1948)(in Italian).

An extensive discussion based on the literature and on the study of 241 clinical cases of Graves' disease treated with

roentgen therapy is presented. The authors discuss the clinical features, indications, technique and method of roentgen therapy, progress during treatment, complementary medical treatment and the results, which are compared with the results of surgery. Lasting clinical recovery was obtained in 221 (92%); only 25 of these (11%) had slight residual manifestations due to irreversible damage already done to the cardiovascular system or to the liver. Of the remaining cases, 11 severe ones died at varying intervals after the beginning of treatment before this could be completed, and 9 relapsed after a period of complete remission. It is concluded that roentgen therapy is indicated as the treatment of choice in every case, including the severest, together with symptomatic treatment.

2171 Hodgkin's Disease of the Lung: Roentgen Appearance and Therapeutic Management. Archie Sheinmel, Bernard Roswit, and Lewis R. Lawrence. Radiology 54, 165-79(1950) Feb.

The results of 35 cases of Hodgkin's disease of the lung are presented. Of these cases, 12 received x-irradiation alone, while 10 cases were treated only with nitrogen mustard. The radiation technique consisted of cross-firing the pulmonary focus through multiple small portals, with special beam-angulation and localization devices. Treatment was given daily by a 200- to 220-kv machine with a Thoraeus filter at target distance of 50 cm and usually 150 to 200 r was delivered until a total of 1,500 to 2,000 r was reached; the course of the therapy was then re-evaluated on the basis of the response noted and, if necessary, irradiation was continued to a total tumor dose of 2,500 to 3,000 r. Radiation sickness, when it occurred, was effectively controlled by the use of desoxycorticosterone acetate. The technique of administration of the nitrogen mustard is also outlined. In three of the 12 cases treated by radiations alone, the response was considered excellent, because of prompt, marked, and persistent regression of the pulmonary lesion and concomitant symptomatic relief; 4 other cases showed good results, while in 5 cases the response was slight or negligible. Of the 35 patients treated by the methods described, 29 are now dead, only 3 of whom lived more than six months; the six living patients have pulmonary involvement, but it is concluded that the development of pulmonary lesions is of no consistent prognostic significance. 25 references.

2172 Late Results of Roentgen Therapy in Hydrocephalic Conditions in Childhood (I). G. Lischi. Policlinico 105, 1022-8(1948)(in Italian).

The late results (2 to 17 years afterwards) of the x-ray treatment of 43 cases of hydrocephalic conditions are presented; the early results in 22 cases of similar conditions are also included. The technique was the usual one of deep roentgen therapy; two temporal fields 8 × 8 cm, 90 to 150 r/field every other day for a total dosage to 400 to 750 r/treatment. Among the various hydrocephalic conditions (chronic congenital hydrocephalus, encephalopathies with hydrocephalus, post-meningitic and post-traumatic hydrocephalus) chronic congenital hydrocephalus proved the most suitable for roentgen treatment. The first treatment produced a noticeable improvement in 80% of the cases, but relapses frequently occurred; with a further treatment further improvement could be obtained. A total of 40% of 20 cases of chronic congenital hydrocephalus were cured. As a rule

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good results can be obtained in all conditions of hypersecretive hydrocephalus, whereas in obstructive hydrocephalus no improvement can be expected.

2173 The Libido after Therapeutic Elimination of the Ovarian Functions. K. Koppen. Zentr. Gynäkol. 70, 570-576(1948)(in German).

Of 50 women subjected to castration by x-rays or x-rays and radium, 15 showed extinction of sexual desire while the remainder showed no appreciable change in this respect.

2174 Neoplasms of Bone. Bradley L. Coley. New York, Paul B. Hoeber, Inc., 1949. 765p.

This book covers extensively benign and malignant bone tumors of metastases and lesions of the skeletal system simulating bone neoplasm. The etiology, diagnosis and therapy (surgical, constitutional, and radiation) are described. Radiation therapy of bone neoplasms is described in a separate section; separate topics, such as the physical factors involved, the effect of irradiation on bone, indications for roentgen therapy, methods and dosage, the effects of radiations on tumors of the bone, and the effects of radium poisoning on skeletal tissues are presented. Treatment with radioactive isotopes is also briefly mentioned in the chapter considering constitutional therapy. Each section contains an extensive bibliography; an index is provided at the end of the book.

2175 On the Combination of X-rays and Short Waves. R. Birkner and F. Wachsmann. Strahlentherapie 79, 93-102(1949)(in German).

From a survey of pertinent literature it is concluded that it is possible to influence malignant tumors by diathermy, and that a combined diathermy and x-ray treatment appears to be promising. The experience of the author, gained from the treatment of 82 patients, can be summarized as follows: It is possible to influence tumors, but not to remove them completely by diathermy alone. Preceding intensive diathermy reduces the dosage of x-rays necessary to remove malignant tumors, and also shortens the time of therapy. The same result can be achieved by simultaneous daily diathermy and irradiation with x-rays. Injurious effects of the x-ray treatment can be removed by subsequent diathermy. Finally, it is reported that in several instances the combined treatment also was successful in curing ulcers.

2176 On Delayed Radiation Reactions in the Bladder and Rectum and Their Treatment. Walther Hubert. Strahlentherapie 79, 113-26(1949)(in German).

Gynecological radiation therapy often produces harmful after-effects in the bladder and rectum, especially in patients of advanced age. It was found that these effects could be successfully treated with cod liver oil, 20 to 50 cm of which was injected daily into the bladder, and every second day into the rectum, alternating with an injection of camomile tea. In 5 tables the following information derived from the treatment of 27 patients is summarized: distribution of harmful after-effects according to their location and the kind of irradiated uterine or portio carcinoma; age distribution of the patients suffering from various after-effects; time of first occurrence of the after-effects; and the results of the cod liver oil treatment.

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2177 On the Treatment of the Carcinoma of the Penis. B. Bertiglia. Radiologia med. 34, 540-7(1948)(in Italian).

An account is presented on the results of the treatment of 30 cases of carcinoma of the penis; 21 of the cases were treated radiologically and the rest were treated radiosurgically. For the radiosurgically treated patients, Marconi-coagulation was used with contact roentgen therapy of 7,000 to 11,000 r delivered at a distance of 1.5 cm, or 8,000 r at 3 cm. Radium therapy was utilized in 12 cases, 5 to 10 foci of 10 mg applicators being utilized at 3 to 4 cm distance, for a total dose of 140 to 300 mcd. Roentgen therapy had only a complementary use to other forms of irradiations, and usually consisted of radiations delivered by a 180-kv source, with a filtration of 0.5 mm Cu through fields of 10 cm by 15 cm; doses of 200 to 300 r were given for a total dosage of 1,500 to 1,800 r/field. Clinical recovery averaged 40% after 5 years, with the highest percentage attributed to the radiosurgical method.

2178 The Operative and Irradiation Treatment of Malignant Laryngeal Growths. J. Beck. Z. Laryngol. Rhinol. Otol. 28, 82-5(1949)(in German).

A method of x-ray therapy which, it is claimed, avoids irradiation of the skin and intervening healthy tissues is described and its application in malignant laryngeal growths is summarized. Small growths of the vocal cords could be irradiated with a Chaoul tube inserted through the mouth, while larger tumors could be exposed by laryngofissure after tracheotomy, followed by the application of soft x-rays from a pointed anode directly to the affected area. The x-ray treatment was instituted two or three days after the operation and a total of 5,000 to 8,000 r was given in fractionated doses over a period of 14 days.

2179 Periarthritis and Its Treatment with X-Rays. P. Plod. Prakticky Lekar 28, 378-82(1948)(in Czech).

The author reviews the etiology, pathological anatomy, symptoms and differential diagnosis of periarthritis, and evaluates different methods of therapy, regarding x-rays as the most successful. The x-rays were delivered at 160 kv through a 0.5 Cu filter at a target distance of 30 cm, and in doses of 100 r from 2 to 3 portals, every second day; acute cases received a smaller dose daily. The maximal total dose was 600 r, over a long period of time. Of the author's 79 cases, the majority (66) belonged to the group of periarthritis humeroscapularis, the rest having affections of the elbow, radiocarpal joint, small digital joints, knee, and hip; 75% of cases with acute periarthritis humeroscapularis became free from pain and gained free movement of the joint after one week of treatment, and 54% of the group of chronic periarthritis humeroscapularis became symptomless after x-ray therapy.

2180 Present-day Treatment of Cancer of the External Genitals. H. Ramioul. Rev. méd. Liège 3, 545-54 (1948)(in French).

A report is presented on 102 cases of cancer of the vulva, the female urethra, and the penis. The percentage of cures over a period of 5 years was 23.5% for the cases of cancer of the vulva; it was found that recurrences resulted more frequently after x-ray therapy than after surgery. The best treatment is considered to be vulvectomy by means of

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cautery; limited tumors can be treated by contact x-ray therapy. The best treatment of cancer of the female urethra is considered to be radium therapy with needles implanted all around the urethra; nodular involvement was observed in only 14.5% of the cases.

2181 The Radiation Therapy of Malignant Tumors of the Larynx and the Pharynx. Dr. Glauner. Strahlentherapie 73, 411-16(1949)(in German).

A review of the methods and results in the therapy of malignant tumors of the larynx and pharynx is presented. In 20 patients with tumors of the larynx who were treated with protracted fractionated x-ray therapy, the author obtained a 25% three-year cure rate and a 15% five-year cure rate. Given a protracted, fractionated x-ray course, of 90 patients with tumors of the mesopharynx, 10% were free of symptoms for longer than three years and after a period of five years. Of 112 x-ray treated patients with tumors of the hypopharynx, only 3% were symptom-free for longer than five years. The required dosage depended to a large extent on the sensitivity of the tumor, and was 2,000 to 6,000 r delivered in 20 days.

2182 The Radiation Therapy of Vaginal Tumors and of Carcinoma of the Vulva. A. Vonessen. Strahlentherapie 73, 427-34(1949)(in German).

Thirty patients with vaginal carcinoma were treated with radium needles. In 18 cases freedom from symptoms was achieved. Six patients (20%) were healed for a longer period than three years and four (13%) of the patients for more than five years. Two patients were still living, the one, two years and the other three years after treatment; both were free from symptoms. The region around the radium needles received 20,000 to 30,000 r, a dosage higher than in surface radiation. At 2 mm distance from the needle, however, the radiation intensity was one-half of the original value. The average radiation the tumor received varied with its size, and was 6,000 to 10,000 r. If the existence of lymph glands was suspected, the ilium and para-aortal area was x-rayed in three series over eight weeks with 1×500 r and 1×400 r per field. 14 references.

2183 Radiological Therapy of Carcinoma of the Tongue. R. Toppner. Strahlentherapie 73, 403-10(1949)(in German).

This is a review of the three radium methods used in the therapy of carcinoma of the tongue: radium telecurie therapy with a cannon containing 3 to 4 g radium; radium surface irradiation; and, the radium applicator method. It further deals with the x-ray therapy of the lymph nodes of the neck. The results of several clinics are included in tables. 23 references.

2184 Radiotherapy of Acne Vulgaris: Comparative Tests of Treatment Technics. Henry Quastler. Radiology 54, 247-56(1950) Feb.

The purpose of the investigation described was to gather experience in the use of the factorial design method (applicable in situations where a result depends on several factors) under clinical conditions; three radiation factors (quality of radiation, intervals between treatments, and doses) were varied in 60 cases of treatment of acne vulgaris and simultaneously compared. An unfiltered 100-kv irradiation

was compared with a filtered one of 120-kv through 3 mm of Al; irradiation at 100 kv with double the target distance of the first two techniques was also used, in order to equalize the dosage rate and approximately equalize the penetration. Single doses of 37 to 150 r and total doses of 200 to 1,200 r were delivered, and arranged so as to form weekly doses of 60 r, 85 r, and 120 r. A second series consisted of combining doses of 30 r, 20 r, and 10 r with 2, 3, and 6 treatments per week. The results are included in a series of tables and are related to the quality of the radiations, the weekly dosage and the number of treatments per week. It was found that the desired therapeutic effect was obtained with about four treatments, regardless of the quality, dosage, and interval, within the limits tested. It is concluded that adequate acne therapy can be given with smaller doses and shorter intervals than are commonly used at present. 11 references.

2185 Radiotherapy of Dupuytren's Contracture. J. Slanina. Casopis Lekaru Ceskych 87, 867-71(1948)(in Czech).

An account of the results of treatment of 104 cases of Dupuytren's contracture with the radium bomb is presented. The contents of the bomb were 3,016 mg of radium; a filtration of 0.5 mm Pt + 5 mm Cu was included; the first series consisted of six daily treatments of 200 r and the total dose was 1,200 to 7,000 r, according to the extent and duration of the disease. A second series of 1,000 to 1,200 r was given after an interval of three months, and thereafter 200 r were given 4 times at 3 to 6 monthly intervals, where necessary. Out of 11 patients who received a minimum total dose of 2,000 r during the first stage of the disease (induration without actual contracture), 8 were cured; of 15 patients treated during the second stage (contracture of one or two fingers with marked flexion), and receiving a minimum of 3,000 r, 4 were cured and 8 were improved. For the third stage (advanced contracture with joint changes and impossibility of voluntary flexion or extension), surgery was considered to be the method of choice.

2186 Radium Ray Applicator. George Turner. U. S. Patent 2,484,433, Oct. 11, 1949.

This device facilitates the delivery of a uniform radiation intensity (from a radioactive source) to a given area, by varying the distance of the source of radiations from the target subject; it is claimed that the device can be readily loaded, is simple and is safe for both operator and subject. It consists of a protective lead housing, containing rotable rollers over which a cotton belt is run, and an aperture through which the radiations are emitted; the belt is fitted with a given amount of radium needles, and the distance between the radium and the subject is varied by turning the rollers and moving the position of the belt.

2187 Radium Therapy in Partial Hearing Loss. Norton Canfield and David Sudarsky. Ann. Otol., Rhinol. & Laryngol. 58, 957-75(1949) Dec.

The paper deals with the partial hearing loss associated with hyperplasia of the nasopharyngeal lymphoid tissue, and its treatment by radium therapy. In 50 cases of partial hearing loss in children who have been treated with radium, the average dosage was 1,732 mg-min to each side of the nasopharynx, 1,275 to 2,975 mg-min being given. Applicators of monel metal and containing 50 mg of radium were introduced for three 12-min periods at 14-day intervals; in some cases

more applications were required. Improvement was found by audiometric examination in 56% of these children and the same percentage of patients felt improved; 82 of patients were considered by the examiner to have benefited from therapy. It was found that the longer the duration of the partial hearing loss, the poorer is the chance for improvement, and that the percentage improvement was greater in those patients who had received a relatively larger dose of irradiation. There have been no complications of radium therapy reported. 27 references. (auth)

2188 Radium Therapy; Its Physical Aspects. C. W. Wilson. London: Chapman and Hall Ltd., 1948. 224p.

This is a comprehensive survey of the physical aspects of radium therapy, including chapters on the properties and application of radium to medicine, the interaction of high-voltage radiation and matter, methods and theory and apparatus for dosage measurement in γ-ray dosimetry, radium therapy with surface applicators, cavitary and interstitial radium therapy, radium teletherapy, and protection. Some of the topics covered in these chapters are a comparison of radium and radon for medical purposes; absorption of radiations and the effect on the absorbing material; calculation and measurement methods for doses, methods and measurements in cases of surface application and internal therapy; determination of method and dose in teletherapy; and, protection evaluations and recommendations. Tables of radon decay and equivalent dose in mg-hr., inverse square law, and some integrals and formulae for areas and volumes of some regular shapes are given in appendices. References are included after each chapter and the book is indexed.

2189 Results and Method of X-ray Therapy of Carcinoma of the Uterus. Julius Ries. Strahlentherapie 73, 395-402(1949)(in German).

From 1938 to 1941, 1,209 patients with carcinoma of the uterine neck were treated with radium and x-rays; 522 were healed (43.1%). Applications of 50 to 60 mg of radium and 25 to 40 mg of radium were administered to the uterine entrance for 60 to 65 hr; the filtration was 1 mm Pt. Intensive x-ray dosages of 800 r were administered to each of four fields in six sittings and were delivered by a 200-kv machine, with a filter of 1.0 Cu, at a focal target distance of 40 cm, and at the rate of 20.0 r/min. These intensive dosages were followed by 14 abdominal-dorsal irradiations delivered by a 200 kv machine, at a focal target distance of 60 cm with a 3.0 Cu filter, and at 3.84 r/min. The single dose per field was 230 r. A special movable lead-lead rubber filter, corresponding to an isodosage of 60 r/hr, was used to shield the tissues, which had already been highly radiated by radium, from an overdose of x-rays. A new method is described which has been developed since 1943 and is called the total radium tamponade of the uterus. About ten egg-shaped radium applicators, each of which was loaded with 2 to 10 mg of radium, were introduced into the uterus. The average dosage was 4,000 to 5,000 mg/hr. Often the radium treatment was followed by a 12-field course, delivering 450 r, 350 r and 8 × 200 r to each field from a 200-kv machine with a filter of 1 mm Cu at a focal target distance of 40 cm and at 20.0 r/min. Results of this new method are not yet available.

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2190 Results of the Treatment of Uterine Carcinoma from 1 Jan. 1935 - 31 Dec. 1938. Hans Reichenmiller and Heinz Drescher. Strahlentherapie 79, 103-12(1949)(in German).

During a 4-year period 465 patients with uterine carcinoma received treatment, 12 of whom had been treated elsewhere for metastases; 54.7% were operated on while the remaining cases received radium and x-ray treatments. Radium was used 3 times within 3 weeks with intrauterine applications of 2,000 to 3,000 mg-hr and intravaginal applications of 4,000 mg-hr; the filtration was 3 mm Pb. X-ray therapy was given during the radium rest periods; 4 parametrium-spinal fields were irradiated through a filter of 1 mm Cu, at a target distance of 40 cm in single dosages of 533 r. It is concluded that in comparison with former years the mortality has grown and results in healing have gone down. Possible reasons are discussed.

2191 Roentgen Short Distance Irradiation of Surface Tumors. Franz Hammer. Krebsarzt 3, 411-18 (1948) Nov. (in German).

A total of 21 patients with inoperable cutaneous neoplasma were treated with x-ray therapy consisting of radiations from a 50-kv source at a 5 cm target distance with a filtration equivalent to 0.5 mm Al; a dose of 500 to 700 r was delivered daily until the tumor disappeared, and total doses were 3,000 to 10,000 r. Of the 21 patients treated by this method, one died without a local recurrence of the disease and the others demonstrated no symptoms for more than three years.

2192 Roentgen Therapy in Acute Rheumatic Fever. I. Popp. Acta Med. Română 21, 492-8(1948)(in Rumanian).

The results of the x-ray treatment of the arthritis prevalent in acute rheumatic fever cases are presented. It was found that when doses of 50 to 60 r of hard x-rays were applied to the joint or joints most severely affected, pain subsided some hours later and the accompanying fever had a tendency to fall. In mild cases recovery took place after two or three days, and in more severe cases, after 5 to 8 days. The radiation dosage in these cases was repeated if necessary.

2193 Roentgen Treatment of Hydroadenitis Axillaris. N. Lauge-Hansen and S. Lyndrup. Nord. Med. 41, 220-7 (1949)(in Danish).

A total of 357 cases of hydroadenitis axillaris was treated in four groups with x-rays delivered at 128 kv to a field of 15 cm by 15 cm at a target distance of 40 cm; 147 of the cases received the radiations filtered through 0.5 mm Cu + 1.0 mm Al, and 82 of the cases received radiations filtered with 3 mm Al. The optimum results were achieved with a total dosage of 1,000 to 1,200 r; doses of 200 r every day, 300 r every second day, or 400 r every third day were delivered. The patients recovered on an average in 14 days, with out skin reactions.

2194 Treatment of Adenocarcinoma of the Cervix. H. Drescher. Geburtshilfe und Frauenheilkunde 9, 31-7(1949)(in German).

In 1,742 cases of carcinoma of the cervix, 79 were adenocarcinomas, 42 of which were operable. Of 53 patients receiving radiotherapy alone, 4 died (one of embolism, one of sepsis, and two of peritonitis due to perforation); 11 of the patients were in good health after 5 years. Of the 26 operatively treated patients (with or without pre- or post-operative radiotherapy) 8 were in good health after 5 years. The author believes that desirable therapy must take the form of radium and x-ray irradiation; in early cases, operation may occasionally be possible, but must always be combined with irradiation.

2195 The Treatment of Carcinoma of the Body of the Uterus. Braithwaite Rickford. J. Obstet. Gynaecol. Brit. Empire 56, 41-5(1949) Feb.

Of a total of 136 cases of carcinoma of the uterine body, 101 were treated initially by surgery alone, and 20 were treated initially by radium. The amount of radium used, and its method and time of application varied considerably; a total of 4,000 mg-hr was the lowest dosage given, and at many times as much as 7,000 mg-hr was administered. The five-year survival rate for all of the patients followed up was 61.1%, while the relative five-year survival achieved initially by surgery was 74.7% as compared with 20% achieved through initial radium therapy. Early post-operative radium therapy of the vaginal vault is suggested as being the most likely method of improving the over-all results. 12 references.

2196 Treatment of Certain Types of Deafness by Roentgen Ray Therapy. N. A. Youngs and P. H. Woutat. Ann. Otol., Rhinol. & Laryngol. 57, 984-91(1948) Dec.

A report is presented on a group of 116 patients treated by deep x-ray therapy for deafness caused by lymphoid tissue obstruction of the eustachian tube or by lymphoid infiltration along the tube or in the middle ear cavity. All patients received radiations delivered at 200 kv through a filtration of 0.5 mm Cu + 1.0 mm Al, at a target distance of 50 cm; each treatment consisted of a dose of 125 to 150 r to each of two ports, which included the middle ear, the eustachian tube and the nasopharynx. Group I patients, 3 to 15 years of age, comprised 63 of the patients, 37 of whom regained normal hearing after the treatment, while only 7 showed no improvement. Of the 53 patients in group II, 15 to 62 years of age, 9 experienced restoration of normal hearing while 15 showed no improvement at all. The dosage as outlined here is concluded to be adequate to combat chronic infection and to reduce lymphoid tissue, but not enough to damage the skin and the other normal structures irradiated.

2197 The Treatment of Early Carcinoma of the Cervix Uteri. James A. Corscaden. Am. J. Obstet. Gynecol. 59, 272-81(1950) Feb.

The results of the treatment of 149 cases of early cervical carcinoma with combined intracavitary radium and external x-ray therapy are presented and compared with results obtained by similar techniques and by the Wertheim hysterectomy. The intracavitary radium technique employed from 1929-1937 consisted of 100 mg of radium in a tandem into the cervical and uterine canal and a 25 mg tube into each lateral fornix and against the cervix, for a total of 175 mg; the applicators were left in place 40 hr, delivering a 7,000 mg-hr total dose. Because of intestinal injuries, this technique has since been modified. The 1219 cases considered here were treated by a method consisting of the insertion of 30 mg or 40 mg of radium in tandem into the cervix and corpus, 10 mg into each lateral fornix and against the cervix; the filtration was 1 mm Al and 5 mm of gauze,

and a total of about 6,000 mg-hr was delivered in 100 hr. X-ray therapy through two anterior and two posterior ports at 200 kv with a 1 mm Cu and 1 mm Al filtration and a target distance of 50 cm was also given, in doses of 200 to 400 r daily; a total of 2,000 r (in air) to each port was administered. It was found that some of the cases received inadequate irradiation due to distortion of cervix and vagina. The results show a 76% five-year survival rate for the stage one cases and 43% for the rest of the 149 cases considered by the author; this compares favorably with a 70% survival in the stage one review cases treated by the same technique and 40% for all stages. The Wertheim five-year survival rates were 38.9-64.7%. 38 references.

2198 Treatment of Graves' Disease with Roentgen Rays and Iodine. H. Rasmussen. Nord. Med. 37, 367-70 (1948)(in Swedish).

A small series of patients with Graves' disease, treated with iodine and roentgen rays in 1943-1945, were re-examined in 1947 and the results are presented here. The patients were found to be free from signs of thyrotoxicosis; opinions in the literature differ with regard to the effect of roentgen therapy on Graves' disease.

2199 Treatment of Vaquez' Disease with Radioactive Phosphorus. S. Simon and J. Henry. Acta Clin. Belg. 4, 382-7(1949) Sept.-Oct. (in French).

The detailed results of the treatment of four cases of the polycythemia known as Vaquez' disease with radioactive phosphorus, P^{32}, are presented. Count depression rates are included and it was noted that a prolonged latent period before effective action of the isotope occurred; frequent hematological examinations (leucocyte and platelet counts) to follow closely the course of the disease and the therapy are recommended. The results obtained through the radioisotope method are compared with those obtained with other therapeutic agents.

2200 Tropism of Iron in Experimental Tumors under the Action of Roentgen Treatment. L. Balli. Radiologia Sperimentale 2, 243-8(1948)(in Italian).

It was found that colloidal iron injected hypodermically in four injections of 0.5 ml each at three-day intervals into healthy white mice, was deposited in the lungs, kidneys, spleen and liver. X-ray therapy altered neither the localization of the deposits or the quantities deposited. Animals with Ehrlich's adenocarcinoma showed only small deposits of the injected iron within the capsule of the tumors, but when the animals were subsequently irradiated by a 150-kv machine with a filtration of 0.5 mm Cu + 2.0 mm Al, at a target distance of 50 cm, with four doses of 25 r each, there was an increase in the iron deposition, both in the organs and in the tumor tissue. The mechanism of action of x-rays in the instance is still unknown.

2201 The Short-Distance Irradiation of Surgically Exposed Carcinoma of the Larynx and Other Growths in Otorhinolaryngology. G. Barth. Z. Laryngol. Rhinol. Otol. 28, 85-9(1949)(in German).

The advantages of the Chaoul short-distance type of x-ray therapy in the treatment of surgically exposed carcinoma of the larynx and other growths are discussed; the split-dose method calls for the delivery of a total of 8,000 r through

daily doses of 400 r. Carcinoma of the larynx was irradiated with the aid of a peroral endolaryngeal tube or through a laryngofissure; tumors of the maxillary antrum were exposed through various procedures and irradiated, and growths of the nasal septum were similarly treated, while middle and inner ear tumors were first removed and then irradiated. Good results were obtained with the Chaoul treatment; local cervical metastases showed good response and tumors of the parotid gland could be irradiated without damage to the facial nerve.

2202 Very Small Dosage X-ray Therapy of Panaritium. Rudolf Pape and Rüdiger Seyss. Strahlentherapie 80, 121-32(1949)(in German).

Excellent results were obtained in the treatment of superficial, subcutaneous, osseous, articular, and tendonous panaritium with very small x-ray doses of 5 to 15 r daily. A total of 76 patients were treated, 23 of whom were healed after 6 sittings, and 32 after 10 sittings. Only 11 (14%) needed more than 10 doses of irradiation. 41 references.

2203 X-ray Therapy of Inflammations. Max Tretter. Strahlentherapie 80, 475-81(1949)(in German).

The forms of x-ray treatment of the sweat glands, lymphoma colli, mastitis, panaritium and such inflammatory processes as arthritis deformans, periarthritis, epicondylitis, furuncles, carbuncles, periodontitis, and periostitis are discussed and results are indicated; one case each of osteomyelitis of the femur and chronic osteomyelitis following war wounds, tuberculosis of the bone and actinomycosis of the neck, and 10 cases of tonsilitis are also mentioned. For all these cases, x-ray therapy was recommended in preference to surgical treatment, since it was thus possible to change a progressive inflammatory process into a local one.

2204 X-ray Therapy of Pain. Wolf S. Reichel. Strahlentherapie 80, 483-534(1949)(in German).

This is a voluminous paper on the physiology of pain and the role of x-ray therapy in all conditions where pain is involved. X-ray therapy was given in 253 cases of etiologically different painful illnesses. An improvement was obtained in 82% of the cases, with 55% showing great improvement and healing; in 18%, pains could not be relieved. In cases of neuralgia and arthrosis, x-ray therapy gave the best results, with improvement in 86% and 87%, but neither the rheumatic nor the chronic forms of arthritis were much influenced by radiations. In cases of incurable cancer with bone metastases and peripheral neuralgia, radiation had a mitigating effect on the pain. The author prefers the surgical method in cases of ulcer. Surface doses in cases of neuralgia varied from 70 to 200 r, depending on the state of the condition and the degree of localization. Irradiations were delivered by a 160 to 180-kv, with a 0.65 mm Cu filter; if a protracted irradiation was indicated, the focal-skin-distance was 40 cm for 10 - 20 r/min, or 30 cm for 20 to 30 r/min. In acute cases, one field method with short intervals of 3 to 4 days was found superior to the multiple method, which was mainly utilized at weekly intervals in chronic cases. 171 references.

2205 X-ray Contact Treatment of Cancer of the Larynx through a Window in the Thyroid Cartilage. L.

Hörbst and E. Ruckensteiner. Europäische Medizinische Rundschau 2, 3-7(1949)(in German).

This article is similar to one in Krebsarzt 4, 191-196(1949) June, an abstract of which appeared in Nuclear Science Abstracts as abstract No. 3-1528.

2206 X-ray Treatment of Graves's Disease. Wolf S. Reichel. Strahlentherapie 80, 133-40(1949)(in German).

Within the last 20 years, about 600 cases of Graves's disease have been treated with x-ray at the University Clinic in Rostock; until 1932, the simple-fractionated, short-time method was used with which 71% healing results were obtained; from 1932 onward the protracted-fractionated, long-time method was practiced which achieved healing results in 81% of the cases. The total dosage with the new method was 1,200 to 2,000 r, given in 2 to 3 courses of five 100 to 150 r doses each, at the rate of 4 to 5 r/min. The effect of the radiation on the thyroid gland is considered to be functional. The described x-ray therapy of Graves's disease yielded results comparable to those achieved through surgical methods.

2207 The Amelioration of Symptoms of Fluorosis by Aluminium Salts. K. Venkataramanan and N. Krishnaswamy. Indian J. Med. Research 37, 277-82(1949) July 3.

A brief review of previous observations is given and the problem of this experiment is discussed. Three groups of young albino rats were observed (controls, those fed fluorine alone, and those fed fluorine plus aluminum salts) as to effects on teeth and general condition up to 15 weeks after the administration; the animals were then sacrificed and 3 from each group were chosen for epiphysis and femur fluorine bone analyses. The results are tabulated and discussed. The authors show that aluminum salts in the diet ameliorate induced fluorosis in albino rats in that they reduce skeletal fluorine storage. 16 references.

2208 Track Demonstration of Radioactive Substances in Biological Tissues in Special Reference to the Diagnosis of Radium Poisoning. Hermann Schaefer. Strahlentherapie 78, 563-8(1949)(in German).

The normal amount of radium in living tissues has been determined to be about 10^{-13} to 10^{-12} g radium/g tissue. This means that 1 g of tissue sends out 0.037 α particles/sec or about 2 α particles/min. For these measurements a newly developed point-counter (A-Krebs) and counting tube have been used. However, a better method is available; the particle track demonstration of α particles in a photoemulsion. Gained by this method was the knowledge that the active substance does not only exist in molecular dispersion in the tissue but also in colloidal solution and suspension. Thorotrast has been investigated with the same method and it was found that the total (α-particle) activity of an ampul of 12 cc thorotrast is 2.25×10^{-8} g radium eq which for an organism of 60 kg weight would be 3.75×10^{-13} g radium eq/g tissue. If thorotrast (after intravenous injection) would be evenly distributed in the organism, the dosage should not cause any damage; but in the reticular endothelial system it reaches much higher concentrations. The much stronger α radiations of the radioactive decay products become a great

danger to the organism. One thorotrast tumor was subjected to the same investigation; microtome sections after fixation showed unexplained high contents of 2.0×10^{-8} g radium eq/g tissue. Thorium X (as used in the thorium X therapy of Troch) does not show any selective accumulation in any tissue after intravenous injection. There exists a difference in the activity of different tissues; after an intravenous dosage of thorium X, the spleen exhibited the highest activity; the liver and tumors of the lungs exhibited smaller concentrations. Another new result is that in a platinum-eosin-sol loaded with thorium X, the latter is always only molecularly dispersed, whereas the activities in the tissue occur also in aggregations.

2209 Studies of the Metabolism of Thiourea II. The Metabolic Fate of Thiourea in the Thyroid Gland. John Schulman, Jr. AECU-713, nd. 17p.

It has been suggested that thiourea prevents the formation of organically bound iodine by saturating the mechanism of the thyroid gland, which under normal conditions, oxidizes iodide ion. By the use of radioactive tracer techniques, it has been shown that S^{35}-labeled thiourea, administered to a rat, is oxidized to sulfate in the thyroid gland. This oxidation of thiourea by the thyroid gland offers a method of studying the oxidizing mechanism of the thyroid gland. 27 references.

2210 Cation Exchange Between Cells and Plasma of Mammalian Blood. I. Methods and Application to Potassium Exchange in the Human. C. W. Sheppard and W. R. Martin. ORNL-458 Feb. 2, 1950. 44p.

The exchange of potassium between cells and plasma of heparinized human blood has been studied in vitro using the radioactive isotope K^{42}. The changes in cell and plasma specific activity are characteristic of a simple two-compartment system. The mean of 7 determinations of the exchange rate at 38°C. is 1.8% of the cellular potassium per hour. The results indicate that at 38°C the rate is relatively insensitive to oxygenation or reduction of the hemoglobin, and to 2500 r of x-radiation. With varying temperature the rate follows pseudo first order kinetics with a Q_{10} of 2.35. Below 15°C the rate of loss of potassium exceeds the rate of uptake. 19 references. (auth)

2211 Aerobic Formation of Fumaric Acid in the Mold Rhizopus Nigricans: Synthesis by Direct C_2 Condensation. J. W. Foster, S. F. Carson, D. S. Anthony, J. B. Davis, W. E. Jefferson, and M. V. Long. ORNL-492, Feb. 1, 1950. 17p.

Recent studies (Foster, J. W. and Davis, J. B., J. Bact., 56, 329-38(1948)) have demonstrated that fumaric acid formation from glucose by Rhizopus nigricans No. 45 involves at least two mechanisms, one of which is aerobic, the other anaerobic. The aerobic mechanism is the subject of the present work. Conditions for obtaining high yields of fumaric acid from ethanol by Rhizopus nigricans are specified. Yields of fumaric acid were so high that the tricarboxylic acid cycle as a mechanism of formation of fumarate is excluded. Yields of fumarate from acetate are one-third those from alcohol. Experiments with unlabeled ethanol and C^{14}-labeled carbon dioxide eliminate a CO_2 fixation mechanism of fumarate synthesis. The mold possesses an enzyme which oxidizes

succinate to fumarate. Fumarate formed from C^{14} methyl-labeled ethanol contains the same specific activity in the methine-carbon as that of the methyl group from the starting ethanol. The carboxyls contain a small amount of radioactivity due to a reversible decarboxylation reaction probably involving oxalacetate decarboxylase. Fumarate from C^{14} carbinol-labeled ethanol contained no radioactivity in the methine-carbons, but abundantly in the carboxyls. All the evidence proves unequivocally that the C_4 dicarboxylic acid synthesis occurs by direct $2C_2$ condensation as hypothesized originally by Thunberg. The implications of this reaction in the tricarboxylic acid cycle of respiration and in synthesis of tracer intermediates for biochemistry and synthetic organic chemistry are discussed. 18 references (auth).

2212 Carbon Dioxide Fixation by Green Plants. A. A. Benson and M. Calvin. UCRL-551, Jan. 3, 1950. 36p.

This review paper is concerned primarily with the carbon assimilation aspects of photosynthesis which are susceptible to study with C^{14}. Emphasis is placed upon the sequence of compounds formed in photosynthesis and its relation to other anabolic and catabolic processes. The authors conclude that it is clear that with the advent and development of the tracer method for following carbon in plant metabolism the means for determining the detailed and manifold reactions through which carbon passes into the structure of the plants is at hand. Although some progress in this direction has been made, considerably more time and the efforts of many more laboratories will be required before a clear picture will be obtained of the chemical reactions and interrelations taking place in plants. It is not to be expected that this type of work will lead directly to a solution of the unique problems of photosynthesis, the knowledge of the act or acts by which electromagnetic energy is transformed into chemical energy. As a result of studies with tracer carbon it is believed that the solution of the problem is more likely to be found in investigations of the photochemical production of oxygen by isolated chloroplasts (grana) in the presence of suitable oxidizing agents. 68 references.

2213 The Path of Carbon in Photosynthesis. VIII. The Role of Malic Acid. James A. Bassham, Andrew A. Benson, and Melvin Calvin. UCRL-584, Jan. 25, 1950. 11p.

Malonate has been found to inhibit the formation of malic acid during short periods of photosynthesis with radioactive carbon dioxide. This result, together with studies which show the photosynthetic cycle to be operating normally at the same time, indicates the malic acid is not an intermediate in photosynthesis but is probably closely related to some intermediate of the cycle. Absence of labeled succinic and fumaric acids in these experiments, in addition to the failure of malonate to inhibit photosynthesis, precludes the participation of these acids as intermediates in photosynthesis. The experimental data were obtained by radioactive tracer means with use of paper chromatography and radioautography. 10 references. (auth)

2214 The Distribution of P^{32} in the Mononucleotides of Normal and Regenerating Liver Ribonucleic Acids. Elliot Volkin and Charles E. Carter. ORNL-585, Feb. 14, 1950. 13p.

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This paper deals with the P^{32} turnover in liver ribonucleic acid purified by the guanidine salt method. The specific activities of the component monoribonucleotides were determined following mild alkaline degradation of the parent nucleic acid and separation of the mononucleotides on the anion-exchange resin, Dowex-1. One hour after injection of inorganic P^{32} into the rat, the adenylic acid moiety of the ribonucleic acid had about 50% higher specific activity than the other mononucleotides, the specific activities of the latter being comparable. The isomeric adenylic acids were equally labeled. The mononucleotide composition and specific activity of regenerating rat liver ribonucleic acid followed the same pattern as the normal, although specific activities of the mononucleotides were about 3 times higher than their normal counterparts. 13 references.

2215 Amino Acid Metabolism in Torulopsis Utilis. Gösta Ehrensvärd. In Cold Spring Harbor Symposia on Quantitative Biology, Vol. XIII, pp. 81-7. Cold Spring Harbor, L.I., N.Y., Biological Laboratory, 1948.

The results of previous work on amino acid metabolism are outlined and discussed. Experiments were designed to test to what extent N uptake was from: the ammonia N obtained by deamination; the formation of amino acids by transamination of keto acids; and, the incorporation of amino acids of the substrate, directly or indirectly into the protein framework. $C^{13}O_2$ was used in experiments on CO_2 fixation, on the uptake of carboxyl-labeled glycine and D- and L-alanine, and on the uptake of C^{13}-labeled D- and L-alanine. Details and results of these experiments are given and the problem is discussed. 16 references.

2216 The Application of the Isotope Technique to the Study of the Metabolism of Glycine. D. Rittenberg. In Cold Spring Harbor Symposia on Quantitative Biology, Vol. XIII, pp. 173-9. Cold Spring Harbor, L.I., N.Y., Biological Laboratory, 1948.

This is a discussion of the technique and metabolism assay of glycine. A few experiments are mentioned in which various substances were injected and attempts were made to trace the metabolic mechanisms involved in glycine anabolism. Radiocarbon, radionitrogen and deuterium were used in the determinations. 23 references.

2217 Biochemical Studies of Virus Reproduction: III. The Origin of Virus Phosphorus in the Escherichia Coli T_6 Bacteriophage System. Lloyd M. Kozloff and Frank W. Putnam. J. Biol. Chem. 182, 229-42(1950) Jan.

This investigation was carried out with P^{32}-labeled host cells and medium. A discussion of the effects of radioactivity on the growth of E. coli and T_6 bacteriophage, the exchange of P^{32} by bacteriophage, labeled medium, and cells, and differentially labeled cells as a source of phage P is presented. Data on the phosphorus content and radioactivity, of cells and P-containing compounds analyzed from cells and virus are given. The authors conclude that only a small fraction of the bacterial protoplasm is utilized in virus protein synthesis but postulate other sources and suggest a picture of viral reproduction on this basis. 22 references.

2218 Biochemical Studies of Virus Reproduction: IV. The Fate of the Infecting Virus Particle. Frank W. Put-

nam and Lloyd M. Kozloff. J. Biol. Chem. 182, 243-50(1950) Jan. (See also NSA 1-1508.)

The role and fate of the original infecting virus particle was determined by P^{32} labeled virus. The methods of labeling, infection, and isolation of phage progeny are described and the results of multiple infection by labeled phage, mixed infection by labeled and unlabeled phage, and phage growth without removal of unadsorbed labeled phage are discussed in relation to an hypothesis of independent reproduction of parts of the phage. The authors conclude that the original particle is disrupted in the cell and one-third of the P^{32} is transferred to the progeny. 19 references.

2219 The Biological Oxidation of Fatty Acids. Samuel Gurin and Dana I. Crandall. In Cold Spring Harbor Symposia on Quantitative Biology, Vol. XIII, pp. 118-28. Cold Spring Harbor, L.I., N.Y., Biological Laboratory, 1948.

This is a review of the work done on the mechanisms by which fatty acids are converted to two-carbon particles (which can serve as precursors of acetoacetate), the reactions involved in the complete oxidation of these particles to CO_2 and water, and the nature of the two-carbon particles. Most of the work discussed involves the use of C^{14} differentially-labeled compounds. A discussion of further problems to be treated is included. 57 references.

2220 The Biological Synthesis of Lipids. Konrad Bloch. In Cold Spring Harbor Symposia on Quantitative Biology, Vol. XIII, pp. 29-34. Cold Spring Harbor, L.I., N.Y., Biological Laboratory, 1948.

This is a review of the work done using tracers, especially C isotopes, and deuterium, in determining the details of the metabolism, sources, and mechanisms involved in lipid synthesis in rats.

2221 The Biosynthesis of Porphyrins. David Shemin. In Cold Spring Harbor Symposia on Quantitative Biology, Vol. XIII, pp. 185-92. Cold Spring Harbor, L.I., N.Y., Biological Laboratory, 1948.

Glycine-N^{15} was fed to a human for three days and the N^{15} concentration of many compounds was determined and plotted against time; several labeled compounds were fed to rats to determine the role of glycine in the synthesis of the protoporphyrin of hemoglobin. Isotopic glycine was also fed to a chicken and blood analyses were performed; observations on the cellular half-life were found to be in agreement with other work using P^{32} labeled erythrocytes. Other experiments, such as clinical studies on patients with sickle cell anemia and the analysis of hemin from duck blood incubated with glycine-N^{15}, were performed; studies on the precursors of heme are included. Further work is suggested in order to determine the source of the various atoms of the porphyrin molecule; use of C^{14}- and deuterium-labeled compounds and cells might be made to facilitate such studies. 24 references.

2222 Comparative Metabolism of Radium, Strontium, and Calcium. William P. Norris and Walter Kisieleski. In Cold Spring Harbor Symposia on Quantitative Biology, Vol. XIII, pp. 164-172. Cold Spring Harbor, L.I., N.Y., Biological Laboratory, 1948.

Sprague-Dawley rats, kept on a constant diet, received Ca^{45} or Sr^{89} ^{90} intravenously; 40 μc of Ca, 115 μc of Sr, and 25 μc

of Ra were included in the injections, respectively. Time determinations on the blood, feces, urine, and skeletal levels of the elements were then performed, the results of which are tabulated and discussed. Other similar experimental courses were run, 0.02-0.91 μc/g of body weight of radium per animal being administered intraperitoneally to 100 Sprague-Dawley rats; the retention was measured as before. 38 references.

2223 Design and Interpretation of Carbon Isotope Experiments in Bacterial Metabolism. S. F. Carson. In Cold Spring Harbor Symposia on Quantitative Biology, Vol. XIII, pp. 75-80. Cold Spring Harbor, L.I., N.Y., Biological Laboratory, 1948.

This is a review of the use of microorganisms in studies of metabolism, especially systems which may otherwise be hidden, and of the design of complex tracer experiments which would throw more light on these systems. CO_2 utilization by heterotrophic systems, the Thunberg-Wieland acetate condensation, the oxidative decarboxylation of pyruvate, and oxalacetate formation from pyruvate and CO_2 are discussed extensively as illustrations of work along these lines.

2224 The Distinction by Means of Tracers Between Active Transport and Diffusion. The Transfer of Iodide Across the Isolated Frog Skin. Hans. H. Ussing. Acta Physiol. Scand. 19, 43-56 (1949).

The object of this paper is to present a theory of behavior of free ions under the combined influence of concentration and potential gradients. Experiments were performed with radio-iodide I^{131} on the skin of Rana pipiens in order to decide whether the iodide passes through in a free state or due to active transport; the experiments are described in detail. It was found that for a free ion diffusing through a membrane the ratio between the flux in one direction and the simultaneous flux in the opposite direction is independent of the structure of the membrane; this ratio is equal to a ratio between the electrochemical activities of the ion on two sides of the membrane. The ion I^- diffuses inwards faster than outwards under all the conditions studied, but it is claimed that no active transport of the ion need be postulated since the potential difference across the skin is somewhat higher than required to explain the difference in the diffusion rate.

2225 The Distribution of Food in Amoeba Cytoplasm Studied by Means of Autoradiography. N. Andresen, C. Chapman-Andresen, H. Holter, P. K. Jensen, and Hilde Levi. Exptl. Cell Research 1, 139-42 (1950) Jan.

The distribution of food material in the amoeba (Chaos chaos) was studied with the aid of radioactive carbon, C^{14}. The C^{14} was first incorporated by assimilation into algae (Chlorella sp.) which live as symbionts in the cytoplasm of a large ciliate, Stentor polymorphus; when the stentors reached the value of 283 counts/min/individual, they were fed to the amoebae, and, at various intervals after ingestion, the amoebae were fixed, with or without previous centrifugation, cut, and the slices were examined for radioactivity by exposure to photographic film. It was found that the radioactive material is confined to the food vacuoles in the early stages of digestion, but after 60 hr is uniformly distributed over the whole amoeba, which may indicate that the material is taken up by the hyaloplasm, or the mitochondria

and other inclusion bodies. It is concluded that this evidence seems to support the assumption that the crystals and like particles are not formed within the food vacuoles, but that the food material is transferred directly to the cytoplasm to join the general metabolism. More experiments will be reported later.

2226 The Distribution of Orally Administered Radioactive Methylthiouracil in Cockerels. J. J. Bezem, F. Brunnekreeft, M. J. E. Ernsting, J. Lever and W. Th. Nauta. Acta Endocrinol. 3, 151-5(1949).

The absorption of the antithyroid drug 4-methyl-2-thiouracil and its retention and elimination in 15-week-old cockerels was investigated through the use of radiosulfur. Upon analyses for radioactivity, it was found that after 24 hr the thyroid gland, the shaftbase of the feathers, and pituitary contained appreciable amounts of the drug, while other organs showed little or none. Excretion was almost complete after 96 hr; a tendency for accumulation of the drug was noted following repeated dosages.

2227 The Effect of Bromobenzene and 3,4-Benzpyrene on the Metabolism of Radioactive l-Cystine. Helmut R. Gutmann and John L. Wood. Cancer Research 10, 8-12(1950) Jan.

The effects of bromobenzene and 3,4-benzpyrene on the sulfur metabolism of the male rat were investigated with the aid of l-cystine labeled with radioactive sulfur, S^{35}, and injected intraperitoneally. Isolation of radioactive bromophenylmercapturic acid from the urine of the rats which had received bromobenzene showed that the S^{35} administered as l-cystine was utilized for the synthesis of mercapturic acid. About 4% of the S^{35} appeared in the mercapturic acid fraction within 24 hr after the simultaneous administration of bromobenzene and l-cystine; less than 10% of the total mercapturic acid excreted in 24 hr came from exogenous sulfur. The administration of 3,4-benzpyrene produced no effect on the sulfur metabolism of cystine which was injected simultaneously with the hydrocarbon; in particular, there was no evidence for the formation of a mercapturic acid resulting from the conjugation of 3,4-benzpyrene with cystine.

2228 Experiments with N^{15} on Purines from Nuclei and Cytoplasm of Normal and Regenerating Liver. A. Bergstrand, Nils A. Eliasson, Einar Hammarsten, Bo Norberg, Peter Reichard, and Hans Von Ubisch. Cold Spring Harbor Symposia on Quantitative Biology, Vol. XIII, pp. 22-5. Cold Spring Harbor, L.I., N.Y., Biological Laboratory, 1948.

The procedure, data, and results of experiments to determine the nitrogen turnover in purines and protein fractions from cell nuclei and cytoplasm in both nongrowing and regenerating liver of rats are given. After the administration of glycine-N^{15}, adult albino rats were sacrificed at varying intervals and rough analyses for guanine, adenine, and uridine were run, differentiating between cytoplasm and nucleic content. The authors concluded that the protein from regenerating cytoplasm had double the amount of N^{15} present in normal cytoplasm, while the protein N^{15} content of regenerating and nonregenerating nuclei was equal to that of the normal cytoplasm. 17 references.

2229 The Extrahepatic Synthesis of Cholesterol. Paul A. Srere, I. L. Chaikoff, S. S. Treitman, and L. S. Burstein. J. Biol. Chem. 182, 629-34(1950) Feb.

In a series of experiments to determine whether extrahepatic tissues can synthesize cholesterol, several rats were deprived of their gastrointestinal tracts, spleens, and pancreases, and their livers were excluded from the body circulation; the rats were then injected subcutaneously with an isotonic saline solution containing $C^{14}H_3C^{14}OONa$ and 300 mg of glucose at the beginning of the experiment, and also 2 and 4 hr later. Normal rats and rats eviscerated as described above, but in addition deprived of their adrenals and ovarian tissues, received similar doses of the isotopic solution, except that the normal rats did not receive glucose. In vitro experiments were also performed on slices of rat liver, brain, testes, kidney, intestine, and skin. It was found that the functionally hepatectomized rats could convert acetate to cholesterol. In addition to liver and adrenal, the following tissues of the adult rat were found to be capable of converting the acetate to cholesterol: kidney, testis, small intestine, and skin. The brain and skin of the new born rat also synthesized cholesterol, but the surviving brain slices of adult rats completely failed to convert acetate to cholesterol. The hepatic and extrahepatic cholesterol synthesis is discussed at length.

2230 A Field Method of Marking Arctic Mosquitoes with Radiophosphorus. Dale W. Jenkins. J. Econ. Entomol. 42, 988-9 (1949) Dec. (Scientific note).

Fourth instar larvae and pupae of Aedes pullatus and Aedes excrucians were treated with radioactive phosphorus as $KH_2P^{32}O_4$ at 0.2 to 0.3 μc/ml of water, under arctic field conditions at Great Whale River, Quebec, in order to determine the efficiency of this method of tagging wild insects. Highly radioactive larvae, pupae, and adults were produced; the average radioactivity of the adults was 1.44 milli r/hr or ~4,300 cts/min. It is concluded that this method for producing radioactively marked mosquitoes in nature can be recommended for dispersal, flight range, migration, predation, and other ecological studies. (auth)

2231 Formation of Lipids by the Microorganism Phycomyces Blakesleeanus. Karl Bernhard. In Cold Spring Harbor Symposia on Quantitative Biology, Vol. XIII, pp. 26-28. Cold Spring Harbor, L.I., N.Y., Biological Laboratory, 1948.

Determinations of lipid formation by Phycomyces Blakesleeanus were done using deuterium as a tracer metabolized into various fatty acids. A discussion of the method and tables of results are given.

2232 The Inability of Choline to Transfer a Methyl Group Directly to Homocysteine for Methionine Formation. John A. Muntz. J. Biol. Chem. 182, 489-99(1950) Feb.

Isotopic choline was prepared by precipitation from a solution of radioactive trimethylamine (containing N^{15}) and ethylene chlorohydrin; the isotopic choline was incubated in Warburg vessels with homocysteine and rat liver slices, methionine being produced. It was noted, however, that the expected product of the demethylation of choline, dimethylaminoethanol, did not appear; instead, dimethylglycine, the expected product of the demethylation of betaine, was produced. This suggests to the author that in these systems choline does not lose a methyl group directly but must first be converted to betaine before methyl transfer can occur.

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2233 Indicator Experiments with Radioactive Copper on Pregnant and Fetal Animals. G. Schubert, W. Maurer, and W. Riezler. Arch. Gynäkol. 176, 279-92 (1948)(in German).

Using normal and pregnant guinea-pigs, single subcutaneous injections of copper sulfate containing 0.025 mg of radioactive copper were made; at short intervals, the tissues and blood of fetuses and adult animals were examined for radioactivity. In both mother and fetuses, the liver contained large amounts of radioactive copper; this organ is the chief site of storage in the fetus. The values in the blood, liver, bone-marrow, adrenals, spleen, and ovaries were higher in pregnant animals than in nonpregnant controls. In general, it was found that the deposition of copper in the fetal tissues lagged behind that in the maternal tissues; the copper in fetal blood was noticeably lower than that in maternal blood under these experimental conditions. It is concluded that although the placenta does not store copper it is important in the transfer of this metal to the fetus.

2234 The Inhibitory Action of Excessive Iodide Upon the Synthesis of Diiodotyrosine and of Thyroxine in the Thyroid Gland of the Normal Rat. J. Wolff and I. L. Chaikoff. Endocrinology 43, 174-9(1948) Sept.

The experiments described here were designed to test the possibility of blocking the iodination of tyrosine and/or of blocking the coupling mechanism involved in the formation of thyroxine from diiodotyrosine. Forty-two Long-Evans male rats were fed a constant diet, injected intraperitoneally with KI^{131} (5-100 γ), and sacrificed at varying short intervals. Details of the carefully controlled tests, analyses of the thyroid for I^{131} and I^{127}, and calculations are given. The authors conclude that the diiodotyrosine conversion was slower when more I was injected; more diiodotyrosine was synthesized when 5-10 γ of I was injected than when 10-20 times that amount was injected.

2235 Iron Supplies in Foetal and Newborn Rats. A. St G. Huggett and W. F. Widdas. J. Physiol. (London) 110, 386-91(1949) Dec. 31.

Female rats were given a tracer dose of 0.1 mg of labeled iron by subcutaneous injection and rats which were subsequently proved to be pregnant were killed at regular intervals from the 14th day of pregnancy until 49 days post-partum; specimens of maternal and fetal blood were obtained from these animals, dry ashed, and examined for radioactivity. There is no evidence of storage of iron at term as a special mechanism to tide the young through the nursing period; the excess iron/weight ratio at birth is probably, the authors state, a fortuitous circumstance. The maternal commitment of iron to the litter (via the milk) may be twice as great in the 21 days following birth as in the 21 days preceding it. The very rapid growth increase relative to the total iron increase is primarily responsible for the fall in the ratio of iron to weight observed during lactation. It is concluded that a disproportion between the growth-sustaining and iron-supplying properties rather than a deficiency of iron per se ultimately would lead to a state of relative iron deficiency. (auth)

2236 Isotopic Studies of Porphyrin and Hemoglobin Metabolism. I. Biosynthesis of Coproporphyrin I and Its Relationship to Hemoglobin Metabolism. Moisés Grinstein, Martin D. Kamen, Howard M. Wikoff, and Carl V. Moore. J. Biol. Chem. 182, 715-21(1950) Feb.

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Duplicate experiments were performed on healthy mongrel dogs to determine the biosynthesis of coproporphyrin I. The first part of each experiment was designed to confirm the demonstration that glycine nitrogen is incorporated into hemoglobin protoporphyrin and to determine whether coproporphyrin I and stercobilin are formed as by-products in the synthesis of hemoglobin; in each experiment, a dog, made anemic by repeated bleeding, was fed glycine labeled with N^{15} in six divided doses over three days. After samples of blood were taken, the animal was bled to death, and his blood was transfused to another dog made acutely anemic by two bleedings. Subsequently, the second animal was again made anemic by feeding him phenylhydrazine hydrochloride (causing hemolysis of red cells) and his blood was tested at intervals to determine whether the excreted products (coproporphyrin I, etc.) were derived from hemoglobin. It was determined that glycine is a specific precursor in dogs of hemoglobin protoporphyrin, coproporphyrin I, and stercobilin. Coproporphyrin I is formed during the biosynthesis of protoporphyrin IX and does not represent a hemoglobin derivative; it may be a by-product of the synthesis of coproporphyrin III, which may give rise to protoporphyrin IX. Protoporphyrin IX, excreted in the feces of dogs, is apparently a hemoglobin derivative. Stercobilin is derived in part from sources other than circulating hemoglobin breakdown. 25 references.

2237 Isotopic Studies of Porphyrin and Hemoglobin Metabolism. II. The Biosynthesis of Coproporphyrin III in Experimental Lead Poisoning. Moisés Grinstein, Howard M. Wikoff, R. Pimenta de Mello, and Cecil James Watson. J. Biol. Chem. 182, 723-6(1950) Feb.

A dose of 0.8 g of isotopic glycine containing 32 at.% of excess N^{15} was administered to a rabbit (previously poisoned with lead-acetate) by stomach tube in six doses over a three day period; the coproporphyrin III excretion of the rabbit before the experiment was high, 173 γ/day. Two similar experiments were subsequently performed on rabbits with increased coproporphyrin III excretion (one which had been irradiated with ultraviolet irradiation over a 10 by 10 cm shaved skin area). Urine, blood, and feces were collected in all three cases and analyzed for N^{15} concentration. It was found that glycine is a direct nitrogenous precursor of the coproporphyrin III excreted in excess in the urine of lead-poisoned rabbits. It is concluded that the present data confirm the belief that this coproporphyrin III is not related to hemoglobin catabolism, and indicate that it is newly formed as a result of the lead poisoning, rather than a preformed porphyrin which was stored and mobilized. 12 references.

2238 Isotopes in Biology and in Medicine. L. Blanchard. Encyclopédia vétérinaire périodique, No. 7-8, 220-30(1949)(in French).

Results obtained in physiology and therapy by the use of heavy isotopes (H^3, N^{15}) and radioactive isotopes (Na, K, Cu, Ca, Sr, P, F, Cl, Br, I, Fe, Co) are rapidly reviewed. The following are the topics surveyed: A. Physiology: the functions of the thyroid, the metabolism of phosphorus, the chemistry of the muscular contraction, the ion-permeability of

the cell, the metabolism of sodium and potassium, the metabolism in the bone tissue, the synthesis of hemoglobin, the physiological function of copper; B. Therapy: local applications of radioactive cobalt and phosphorus in epitheliomas and hyperkeratoses, oral use of (1) radioiodine in certain cancers of the thyroid and in Bazedow's disease, (2) radiophosphorus in polyglobulosis (erythremia of Vaquez), chronic leukemias, Hodgkin's disease (negative results), multiple myelomas (temporary relief of pain), mammary adenocarcinoma of rats, (3) colloidal radio-manganese in human brucellosis.

2239 Isotopes in Pharmacodynamics. Chalmers L. Gemmill. In Cold Spring Harbor Symposia on Quantitative Biology, Vol. XIII, pp. 99-103. Cold Spring Harbor, L.I., N.Y., Biological Laboratory, 1948.

This is a review of the use of various tagged elements in pharmacodynamics, in the special problems of following the course and fate of various drugs through the body. The author discusses H^3, C^{14}, N^{15}, O^{18}, F^{18}, Na^{24}, P^{32}, S^{35}, Ca^{45}, Mn^{52}, Mn^{56}, Fe^{55}, Fe^{59}, Cu^{64}, As^{74}, Se^{75}, Br^{82}, Sr^{89}, Sb^{122}, Sb^{124}, I^{131}, Hg^{197}, Au^{198}, Pb^{210}. It is concluded that in the future much more use will be made of tagged atoms for tracing small amounts of drugs. 45 references.

2240 Mechanism of Phosphate Transfer Across Cell Membranes. Jacob Sacks. In Cold Spring Harbor Symposia on Quantitative Biology, Vol. XIII, pp. 180-4. Cold Spring Harbor, L.I., N.Y., Biological Laboratory, 1948.

The problems confronted in considering the mechanisms of phosphate transfer are presented in detail here; reference is made to experiments on widely different systems. The use of P^{32} as a tracer in muscle metabolism studies is outlined and results of such experiments are given and related to the problem. The author concludes that available evidence indicates that in muscle, heart, and liver the transfer of phosphates from the extracellular phase to the interior of the cell is linked to a membrane organic phosphate compound oriented spatially so as to be able to easily penetrate the membrane. 20 references.

2241 The Metabolic Fate of Acetyldehydrotyrosine in the Rat. Henry D. Hoberman and Joseph S. Fruton. J. Biol. Chem. 182, 127-9(1950) Jan.

To further test the role of derivatives of α,β-unsaturated amino acids in protein metabolism, three Sprague-Dawley male rats were fasted 24 hr and then administered at 1-hr intervals 5 intraperitoneal injections of 42.5 mg acetyldehydrotyrosine·H_2O (32.29 at.% excess N^{15}) in three cc H_2O, with one equivalent of sodium bicarbonate. Parallel experiments were performed using isotopic acetyl-DL-tyrosine (32.19 at.% excess N^{15}) under the same conditions. Urine was collected for 24 hr and the results of analyses for the total N, urea N, ammonia N, and N^{15} are tabulated separately. The conclusions reached are that in this experiment the dehydroamino acid derivatives are not utilized appreciably for protein metabolism.

2242 The Metabolic Fate of Pentobarbital; Isotope Dilution Experiments with Urine after the Administration of Labeled Pentobarbital. E. W. Maynert and H. B. Van Dyke. J. Pharmacol. Exptl. Therap. 98, 174-9 (1950) Feb.

Sodium pentobarbital labeled with N^{15}, assumed to be evenly distributed between the nitrogen atoms, was administered to dogs by stomach tube and the urine was collected by catheter and drained into bottles containing toluol. The partition of the urinary N^{15} was determined by methods reported earlier. It was found that only negligible amounts of ethyl (1-methylbutyl) acetyl urea and the similarly substituted acetamide and malonamide were present as metabolic products of the drug. The results of similar experiments with ethyl (1-methylbutyl) malonuric acid which indicated the excretion of this compound as a metabolite were shown to be erroneous due to coprecipitation. Ethyl (1-methylbutyl) malonuric acid and the corresponding malonamide were found to possess no hypnotic activity in mice. (auth)

2243 Metabolic Studies with I^{131} Labeled Thyroid Compounds; Comparison of the Distribution and Fate of Radioactive d-l-Thyroxine after Oral and Intravenous Administration in the Human. A. Albert and F. Raymond Keating, Jr. J. Clin. Endocrinol. 9, 1406-1421 (1949) Dec.

The metabolic behavior of racemic radiothyroxine (with I^{131}) administered intravenously was studied in a myxedematous patient, maintained at an euthyroid level with racemic nonlabeled thyroxine. After one half-life of the thyroxine I^{131}, 41% of the radioactivity was excreted in the urine and 12% in the feces; 85% of the urinary I^{131} was present as inorganic iodide and 15% as organic I^{131}, consisting of both thyroxine and diiodotyrosine. This pattern was essentially like that obtained in a similar study in which radiothyroxine was administered orally. Various aspects of the kinetic behavior of radiothyroxine are described. (auth)

2244 The Metabolism of Amytal Labeled with N^{15} in Dogs. E. W. Maynert and H. B. Van Dyke. J. Pharmacol. Exptl. Therap. 98, 180-3(1950) Feb.

After the oral administration of Amytal (45 mg/kg body weight) labeled with N^{15}, dogs excreted about 41% of the dose of excess N^{15} in the urine in the first 24 hr and 81% in 48 hr. The excess N^{15} in the urinary ammonia was negligible; the urinary urea contained about 10% of the dose. Isotope dilution experiments with ethylisoamylbarbituric acid and the similarly substituted malonuric acid, acetyl urea and acetamide revealed that these compounds are excreted only in traces. It is concluded that these results prove that Amytal is not principally detoxified by simple hydrolysis of the barbituric acid ring. The metabolic products of Amytal are excreted at about half the rate of those of pentobarbital. (auth)

2245 The Metabolism of Intravenously Administered Ammonium Glutamate and Glutamine. Max Berenbom and Julius White. J. Biol. Chem. 182, 5-10(1950) Jan.

The intravenous injection of an aqueous solution of ammonium glutamate (containing 14.6 at.% of excess N^{15} in the ammonium group) or of glutamine (containing 14.3% excess N^{15} in the amide group) to male rats of the Osborne-Mendel strain was followed by a rapid removal of the isotope from the blood and relatively slight accumulation of the isotope in the liver or kidneys. The glutamate and the amide nitro-

gen of the glutamine were largely converted to urea and excreted in the urine. With either of these substances only a small fraction of the injected isotope was excreted as ammonia. 29 references. (auth)

2246 A Method for the Study of Blood Loss in Hookworm Infestation. P. F. Hahn and Edward P. Offutt. Science 110, 711-13(1949) Dec. 30.

Two healthy, adult mongrel dogs with red cell hematocrits of 24 and 25%, respectively, (brought about by controlled bleeding over a long period of time) were each infected with about 2,000 larvae of Ancylostoma caninum suspended in saline and applied to the area between the toes and the groin. The animals were fed a diet consisting of white bread, Klim, salmon, and cod liver oil in order to restrict the iron uptake; after a period of 5 to 6 weeks several examinations of feces were begun, and numerous ova of the parasite were found. Four weeks following the application of the larvae each animal received 100 ml of blood from a donor dog which had previously been fed large quantities of radioactive iron while anemic in order to supply red cells tagged with radioactive iron. When the red cell isotope levels of the two dogs were plotted, they showed a regular drop which appeared to be logarithmic, and which was only interrupted for two short periods of time in one dog. The method of calculating the rate of blood loss from the curves set up is presented. It is concluded that loss of blood through hemorrhage by any route lends itself to study by this method. Some criticisms and suggestions concerning the method are also discussed.

2247 The Permeability of Rabbit Leucocytes to Sodium, Potassium, and Chloride. D. L. Wilson and J. F. Manery. J. Cellular Comp. Physiol. 34, 493-519 (1949) Dec.

As part of an investigation described here on the intracellular concentrations of sodium, potassium, and chloride in rabbit leucocytes, and the degree of permeability of the leucocytes to these three common ions, two experiments were performed utilizing Na^{24} as a tracer. It was found that more than 90% of the isotope exchanged with the leucocytes within a 75-min period; a slow continued rate of exchange subsequently occurred. The results of other parts of the investigation are summarized and discussed. 23 references.

2248 Potassium Metabolism in Escherichia Coli. I. Permeability to Sodium and Potassium Ions. Dean B. Cowie, Richard B. Roberts, and Irena Z. Roberts. J. Cellular Comp. Physiol. 34, 243-57(1949) Oct.

Entamoeba coli (strain B) were grown overnight, centrifuged, suspended in a substrate solution, and inoculated with radioactive sodium, Na^{24}, and potassium, K^{42}, for the purpose of determining the permeability of the cell membrane; the precise methods used are described in detail. It was found that the membrane is highly permeable in both directions to ions of sodium and potassium, an equilibrium between the inner water space and the medium being reached within 5 min; no indication of binding of sodium within the cell was found, even during high metabolic activity. The concentration of potassium by the cells is concluded to be due to the formation of nondiffusible potassium compounds during cellular metabolism.

2249 Potassium Metabolism in Escherichia Coli. II. Metabolism in the Presence of Carbohydrates and Their Metabolic Derivatives. Richard B. Roberts, Irena Z. Roberts, and Dean B. Cowie. J. Cellular Comp. Physiol. 34, 259-91(1949) Oct.

The uptake and loss of potassium by E. coli was studied under various conditions through the use of K^{42} employed as a radioactive tracer. The techniques and methods are essentially those described in the first paper of this series (Cowie et al, J. Cellular Comp. Physiol. 34, 243(1949)). The data indicated that while the cell membrane of E. coli is completely permeable to ionic potassium, compounds are formed during carbohydrate metabolism which are not diffusible; in the presence of hexose there is a rapid accumulation of these compounds giving an initial net increase in the quantity of bound potassium. As metabolism proceeds, a steady state is reached where potassium is released as rapidly as it is bound. Data are presented showing the dependence of potassium uptake and loss on the conditions of the medium, and give indirect evidence that the potassium is bound as salts of the hexose phosphates; they also indicate that a large proportion of glucose is utilized (aerobically) by a pathway that does not involve potassium turnover. 59 references. (auth)

2250 Radioiodine Uptake Curves in Humans. III. The Evaluation of Radioiodine Measurements Made with Counter Tube in Apposition to the Thyroid Isthmus. William H. Beierwaltes, Isadore Lampe, Henry J. Gomberg, and George H. Lowrey. Univ. Mich. Med. Bull. 16, 2-6(1950) Jan.

Iodine uptake curves which were obtained from measurements on fasting children after the administration of tracer doses of I^{131} are presented and their correlation with the functional state of the thyroid is discussed. Four myxedematous, 27 normal and 13 hyperthyroid patients were each given approximately 175 μc of I^{131}, and radioactivity counts were made with a cylindrical glass wall Geiger counter tube in a probe case; the probe case was held to the neck at the level of the thyroid isthmus, and counts were recorded for the first 2 hr after the I^{131} ingestion. The range for the 27 normal curves was found to be wide; the curves showed a relative concentration in the middle third of the range suggesting a normal frequency distribution. The 13 curves obtained on the hyperthyroid patients established a fairly well differentiated zone at the end of 2 hr, but showed some overlap with the highest normal curves. Curves on the 4 myxedematous patients fell within the lower third of the normal curve and were not distinguishable from the normal curves in this region. (auth)

2251 Radioiodine Uptake Curves in Humans. IV. Comparative Studies of Short and Long Distance Counting of Thyroid Radioactivity. William H. Beierwaltes, Henry J. Gomberg, and Isadore Lampe. Univ. Mich. Med. Bull. 16, 7-13(1950) Jan.

This paper reports the extent to which contact counts are dependent on the position of the counter, and the elimination of this geometric source of error by counting at a distance where the thyroid can be considered as a point source of radiation. A dose of 4 mc of carrier-free I^{131} was administered to an 80-year-old white male with classic exophthalmic goiter; the gland was not palpable and no nodules were present. It was found from the application of various techniques for the recording of the radioactivity that slight changes in the relative position of counter and gland are of critical importance when the counter and gland are in close proximity.

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It was found that the thyroid gland containing I^{131} could be considered as a point source of radiation at a minimum distance of 25 cm from the counter tube; consistent results with the long-range measurements could then be obtained. It is concluded that the point source principle may be utilized in small tracer dose studies for radioiodine determinations.

2252 The Role of the Gastro-Intestinal Tract in the Excretion of C^{14}-Labeled Methadone by Rats. L. L. Eisenbrandt, T. K. Adler, H. W. Elliott, and I. A. Abdou. J. Pharmacol. Exptl. Therap. 98, 200-5 (1950) Feb.

The object of the present studies was to examine the intestinal excretion of methadone·HBr labeled with C^{14} more precisely and to evaluate the relative importance of the various portions of the gastrointestinal tract in eliminating methadone from the body. The experimental animals were adult albino rats of the Slonaker-Wistar strain; they were injected with methadone subcutaneously in the left hind leg in a dose of 4 to 10 mg/kg; ligation of the stomach at the pyloric valve and analysis of the accumulation of radioactivity in the stomach, and bile collection by cannulation of the common bile duct before and at intervals after the administration of the drug were the investigation procedures utilized. In order to determine the degree of absorption of radioactive material which had been delivered to the small intestine from the liver via the bile duct, portions of radioactive bile from donor rats were injected into the duodenum, and the bile and several organs were subsequently analyzed for radioactivity. It was found that the gastric excretion does not play an important role in the elimination of the drug tested; the accumulation of radioactivity in the stomach is a result of regurgitation from the small intestine, and the presence of radioactivity in the small intestine is the result of the inflow of radioactive bile. It was found that radioactivity makes its appearance in bile within 10 min after a subcutaneous injection and becomes increasingly concentrated. As much as 17% of an injected dose can be recovered from the bile over a 3-hr period and an amount representing 1.5% of the dose is readily reabsorbed from the small intestine during that period. In one pregnant rat, considerable amounts of radioactivity were also found in the fetuses and the placentae. 11 references.

2253 Royal Society of Medicine Meeting Held on January 20, 1950. Lancet 258, 211-13(1950) Feb. 4.

At a joint symposium held by the radiology section with the British Institute of Radiology, the uses of radioactive isotopes were discussed by a group of investigators. Some of the applications brought out were in connection with dynamic equilibria measurements and investigations of the spatial distribution of ingested substances, blood concentration measurements, diagnosis of thyroid disease, and the treatment of thyroid carcinoma, maladies of the internal surface of the bladder, and malignant melanoma of the conjunctiva.

2254 The Significance of Radioactivity for Medicine. R. Glocker. Strahlentherapie 73, 331-338(1949)(in German).

This is a survey of the discovery of radioactivity by Marie and Pierre Curie, and of artificial radioactivity by the couple Joliot-Curie. The structure of the atom is described. A list

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of stable and radioactive isotopes and of the more important isotopes in medicine as Na^{24}, P^{32}, S^{35}, Cl^{38}, K^{42}, Ca^{45}, Fe^{59}, Cu^{64}, I^{130}, and I^{131} with their half-value-times, their average energy of β-radiation and their total dosage after complete decomposition at an initial activity of 1 mc/kg is presented. The importance of radioactive indicators for physiological studies and the role of I^{131} and P^{32} in medical therapy are explained.

2255 Studies on Capillary Permeability with Tracer Substances. Louis B. Flexner, Dean B. Cowie, and Gilbert J. Vosburgh. In Cold Spring Harbor Symposia on Quantitative Biology, Vol. XIII, pp. 88-98. Cold Spring Harbor, L.I., N.Y., Biological Laboratory, 1948.

A theoretical discussion of some problems of capillary permeability which can be attacked with tracer techniques is presented. The rates of turnover of plasma water, NaCl, and ferric β_1-globulinate in the guinea pig and of plasma sodium and water in the human have been determined using radiosodium, radioiron and D_2O (deuterium oxide). On the basis of Fick's law of diffusion and the rate of transcapillary exchange of chloride it is concluded that the whole wall of the capillary, or the endothelial wall, must be permeable to chloride, water, and sodium, rather than the intercellular cement only. The authors conclude that diffusion rather than filtration accounts for the exchange of substances across most capillary walls; it accounts for all but about 0.02% of the total water exchanged.

2256 Studies on the Cyclophorase System. XII. Incorporation of P^{32}. D. E. Green, W. A. Atchley, J. Nordmann, and L. J. Teply. Arch. Biochem. 24, 359-74 (1949) Dec.

The present communication deals with the process by which inorganic phosphate becomes incorporated in or bound to the particulate elements of the cyclophorase system during active oxidation; P^{32} was used as a tracer for the experiment. The cyclophorase gel of rabbit kidney or liver was allowed to carry on active oxidation in the presence of the isotope and at the termination of the run the gel was washed, centrifuged, dissolved in potassium hydroxide solution, and tested for radioactivity. It was found that the P^{32} was incorporated within the gel; reagents like arsenite and capryl alcohol which paralyze oxidation also abolished the P^{32} incorporation. Gramicidin and dinitrophenol in the minimal concentration necessary for blocking esterification of glucose in the presence of the combined cyclophorase-hexokinase system only partially inhibited incorporation of the P^{32}. Gel phosphorus, estimated as inorganic phosphorus, was readily discharged by any of the reagents which are known to transform the oxidases of the cyclophorase system into their classical counterparts. (auth)

2257 Studies on the Cyclophorase System. XIII. Distribution of Radioactivity in Various Phosphorus-Containing Compounds of the Cyclophorase Gel. Harry Albaum. Arch. Biochem. 24, 375-82(1949) Dec.

A study was made of the distribution of P^{32} in various phosphorus-containing compounds extracted with trichloroacetic acid from a liver cyclophorase gel which had been allowed to carry on active oxidation in presence of radioactive phosphate and which was finally washed free of all soluble material.

The bulk of the incorporated P^{32} was found in the trichloroacetic acid extract in a form estimated as inorganic phosphate; the adenine polyphosphate fraction was also highly radioactive, the radioactivity residing in the pyrophosphate moiety. After treatment of the adenine polyphosphate with glucose in presence of hexokinase and myokinase, the radioactivity was transferred to the glucose phosphate fraction. Another adenine polyphosphate fraction, not identical with ADP (adenosine diphosphate) or ATP (adenosine triphosphate), was found in the trichloroacetic acid filtrate; this unknown compound was also highly radioactive. (auth)

2258 Studies on Ethionine: Inhibition of Protein Synthesis in Intact Animals. M. V. Simpson, E. Farber, and Harold Tarver. J. Biol. Chem. 182, 81-9(1950) Jan.

Three virgin female rats, after a 12 hr fast, received intraperitoneally 75 mg of ethionine at 2 hr, 25 mg of methionine at 2.17 hr (containing 6.7-13.4 millimoles of methionine S^{35} with counts of 0.25-4.6 $\times 10^6$/min), and at 3 hr, 50 mg ethionine; at 4.75 hr the animals were sacrificed. Similar courses were run on 2 mice, and on 3 other rats and 2 other mice with glycine S^{35} as the tracer amino acid. Details of the tissue preparation techniques are given and results are tabulated in terms of the specific activity of methionine or glycine. The authors conclude that there is a complex competitive inhibition of methionine and glycine uptake in protein synthesis by ethionine, which is counteracted by methionine. The ethionine inhibition of the conversion of methionine-sulfur to cystine sulfur is also noted and the authors postulate mechanisms for the reaction from the point of view of inhibition of micro-organism growth and protein synthesis.

2259 Studies of the Over-all CO_2 Metabolism of Tissues and Total Organisms. Austin M. Brues and Donald L. Buchanan. In Cold Spring Harbor Symposia on Quantitative Biology, Vol. XIII, pp. 52-62. Cold Spring Harbor, L.I., N.Y., Biological Laboratory, 1948.

The authors discuss factors which must be considered in dealing with over-all metabolism experiments, especially those using $C^{14}O_2$ as a tracer. An extensive discussion of experimental technique and apparatus is given including a theoretical treatment, tables and graphs on results and diagrams of apparatus. It is concluded that CO_2 is efficiently absorbed by the lung and is suggested that the amount needed to reach equilibrium with the blood bicarbonate system depends on alveolar specific activity and is independent of the CO_2 air concentration.

2260 Studies on the Phosphate Metabolism of Some Unicellular Organisms. Martin D. Kamen and S. Spiegelman. In Cold Spring Harbor Symposia on Quantitative Biology, Vol. XIII, pp. 151-63. Cold Spring Harbor, L.I., N.Y., Biological Laboratory, 1948.

This review of work done on phosphate metabolism includes sections on the techniques involved and their reliability, cellular fractionation with special reference to intracellular orthophosphate and the uptake and turnover of phosphate in relation to cellular syntheses; the experiments and their results are briefly covered. The authors conclude that the data presented on the stimulation of the turnover of phosphate appear to be the only clear cut evidence that phosphorylation is mediated by light directly or indirectly in photosynthetic organisms; more data on algae and bacteria are needed. 26 references.

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2261 Studies of Purine Metabolism. George Bosworth Brown. In Cold Spring Harbor Symposia on Quantitative Biology, Vol. XIII, pp. 43-51. Cold Spring Harbor, L.I., N.Y., Biological Laboratory, 1948.

Previous work is incorporated into a rationale for experiments in feeding various N^{15} labeled purines, especially guanine and adenine, and pyrimidines to rats. The details of the procedure and analysis are given and results tabulated to show possible sources, mechanisms, and the metabolic fates involved in purine and pyrimidine metabolism. A discussion of experiments to eliminate cytosine as a nucleic acid nitrogen precursor is included. The author concludes that, except for adenine, all purines and pyrimidines, after they are synthesized are only catabolic products of nucleic acids. Free guanine, although its derivatives serve as components of nucleic acids, must also be included in this class. The in vivo syntheses of pyrimidines, adenine and the adenine moiety to guanine moiety conversion is suggested as proceeding via some intermediary derivative. 48 references.

2262 The Synthesis of Liver Glycogen in the Rat as an Indicator of Intermediary Metabolism. Harland G. Wood. In Cold Spring Harbor Symposia on Quantitative Biology, Vol. XIII, pp. 201-10. Cold Spring Harbor, L.I., N.Y., Biological Laboratory, 1948.

Incomplete but extensive experiments are described on certain elements of intermediary glycogen metabolism in rats; C^{14}-labeled compounds were primarily used in the experiments cited. In vivo mechanisms in many cases were found to be those previously discovered in vitro, such as the fixation of formate in glycogen and the mechanism indicated for the conversion of formate and glycine to serine and serine to glycogen. The authors state that the conversion of formic acid to serine using C^{14} has been demonstrated. 37 references.

2263 Theoretic and Experimental Considerations of Biologic Decay Periods: Studies in Man with the Use of Na^{22}. G. E. Burch, S. A. Threefoot, J. A. Cronvich, and P. Reaser. In Cold Spring Harbor Symposia on Quantitative Biology, Vol. XIII, pp. 63-74. Cold Spring Harbor, L.I., N.Y., Biological Laboratory, 1948.

Some data on the rates of biological decay as influenced by drugs and dietary factors on 4 normal humans, 6 with chronic congestive heart failure, and 2 with a nephrotic syndrome of chronic glomerulonephritis are summarized, and some theoretical considerations which are of interest in tracer work are discussed. Results are tabulated and graphed and a very extensive discussion of the mathematical and theoretical considerations is given. A break-down of biological decay time into several parts (each one of which is to be measured), derivations of equations to predict concentration variation and total content of tracers for various intakes and outputs, and suggestions as to the application of this theoretical approach to tracers other than the Na^{22} decay treated in this paper are outlined.

2264 Uptake of Radioactive Iodine by the Thyroids of Underfed Rats. Joseph Meites and L. F. Wolterink. Science 111, 175-6(1950) Feb. 17 (Technical paper).

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The uptake of I^{131} by the thyroids of starved rats was compared with the uptake noted in control animals in order to determine whether thyroid activity in rats remains unchanged during starvation, when computed on a body-weight basis. Fifty young female rats of the Sherman strain were divided into five groups of ten each and were fed ad libitum, ¾, ½, ¼, and no-feed regimens; the unfed group was sacrificed at the end of 7 days and the other groups at the end of 14 days; 8 hr previous to sacrifice, each rat was injected intraperitoneally with 0.2 ml of carrier-free I^{131} (estimated to contain approximately 2 μc). The thyroids were removed, weighed, dried, and counted and it was found that the weights of the thyroids of the underfed rats were decreased but remained relatively unchanged on the basis of 100 g/body weight. Underfeeding also did not affect the ability of thyroid tissue/μg to concentrate the radioiodine, counts being similar for all the groups. It is concluded that the primary effect of underfeeding was that it did tend, however, to reduce the total thyroid activity.

2265 The Use of Isotopes in an Integral Equation Description of Metabolizing Systems. Herman Branson. In Cold Spring Harbor Symposia on Quantitative Biology, Vol. XIII, pp. 35-42. Cold Spring Harbor, L.I., N.Y., Biological Laboratory, 1948.

This is a mathematical treatment of metabolizing systems, describing some important characteristics of these systems in terms of a rate function and a metabolizing function in an integral equation. The resulting equations are applied to several biological and chemical problems and are solved for several sets of available data. Evidence is given to support the use of this method in tracer work, especially "double tracer" molecules since it suggests a simultaneous determination of rate and metabolizing functions of a metabolite by measurements of one substance in a single system. The equations are developed and compared to differential equations applied to similar problems; the procedure of application is outlined and the uniqueness of the function is discussed.

2266 The Use of the O^{18} Isotope. Ronald Bentley. In Cold Spring Harbor Symposia on Quantitative Biology, Vol. XIII, pp. 11-21. Cold Spring Harbor, L.I., N.Y., Biological Laboratory, 1948.

The paper includes a discussion of the forms of O^{18} in use, some factors affecting its use in biological systems, and densimetric, mass spectrometric, and isotope dilution methods of analysis. An intensive survey of work done and problems to be considered in benzilic acid rearrangement, lactone hydrolysis, the Beckmann reaction, xanthation of alcohols, acetylation with anhydrides in acid and alkali, alkali fusion, phosphate ester hydrolysis, ether synthesis, photosynthesis studies, the Dole effect and metabolism studies, is included with a brief discussion of the significance of some parts of this work. 58 references.

2267 The Use of Tracers in the Study of Active Ion Transport Across Animal Membranes. Hans Ussing. In Cold Spring Harbor Symposia on Quantitative Biology, Vol. XIII, pp. 193-200. Cold Spring Harbor, L.I., N.Y., Biological Laboratory, 1948. (See also NSA 2-2227 and 4-976.)

This is a theoretical discussion including a consideration of (1) the different types of ion exchange, (2) ion transport through isolated frog skin with apparatus and experimental data given, (3) sodium influx and potential difference, (4) sodium and chloride ion transport, (5) the relation between sodium ion transport, and (6) the potential difference and pH. Problems encountered in the use of labeled ions in determining flux are discussed and analogous work on permeability is suggested. 14 references.

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2268 The Kinetics of the Thermal Reaction of Bromine with Carbon Tetrachloride. Alexander A. Miller and John E. Willard. AECU-720, nd. 1p.

The document is in abstract form; it is reproduced below in its entirety.

The reaction of Br_2 with liquid or gaseous CCl_4 to form CCl_3Br is readily measurable at 180 to 250°C. The initial rate is proportional to $[CCl_4][Br_2]^{1/2}$. The reaction is accelerated by added chlorine and therefore is autocatalytic. It appears that both the bromination and the chlorine exchange reaction, which also occurs in the system, are initiated by the reaction of halogen atoms with CCl_4 to produce CCl_3 radicals which can then react with Br_2 or BrCl. The results indicate that the activation energy for the reaction of the atom to produce the radical is 18 kcal/mole for Br and 12 kcal/mole for Cl. It is suggested that Cl_2 accelerates the bromination reaction because CCl_3 radicals can be formed more easily by $Cl + CCl_4 \rightarrow CCl_3 + Cl_2$ than by $Br + CCl_4 \rightarrow CCl_3 + BrCl$.

Approximate values for the equilibrium constant of the reaction $Br_2 + 2CCl_4 \rightleftharpoons 2CCl_3Br + Cl_2$ at different temperatures give a value of ΔH of 11 to 14 kcal/mole which gives a value of approximately 13 kcal/mole as the difference in bond energies of the C-Br bond in CCl_3Br and the C-Cl bond in CCl_4. The results indicate a maximum value of the C-Cl bond strength in CCl_4 of less than 70 kcal/mole.

2269 The Kinetics of the Exchange of Sulfur Between Sulfite and Thiosulfate. Donald P. Ames and John E. Willard. AECU-722, nd. 1p.

The document is in abstract form; it is reproduced below in its entirety.

The exploratory work reported by Voge showing that exchange occurs between sulfur in sulfite and thiosulfate in aqueous solution at 100°C. has been confirmed and the kinetics of the reaction investigated. The reaction rate is proportional to the first power of the gross sulfite concentration in the range from 0.2M to 0.02M, both at pH = 5 where 99% of the reactant is present as bisulfite and at pH = 12 where it is all present as sulfite. It is proportional to the first power of the thiosulfate concentration in the range from 0.2M to 0.02M at pH = 5. The activation energy at both pH = 5 and pH = 12 was found to be between 14 and 15 kcal/mole. The experiments have been made at a constant ionic strength of 2 obtained with the aid of added NaCl. The results suggest the conclusions that the reaction does not occur through the intermediate step $S_2O_3^= \rightarrow SO_3^= + S$. The results also show that the two sulfur atoms in thiosulfate are not equivalent and do not exchange in 5 hr heating at temperatures up to 125°C.

2270 The Stability of Gaseous Ferrous Oxide. Leo Brewer and Donald F. Mastick. UCRL-534, Nov. 30, 1949. 20p.

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The vapor-pressure of iron has been determined by the effusion method between the temperatures 1745 and 1856°K. Variation of the size of the effusion hole gave no appreciable change in the measured vapor-pressures and thus the sticking coefficient is greater than 5.53×10^{-3}, the area of the effusion hole. Actually, since these measurements agree within experimental error with those made by measuring the rate of vaporization from a free iron surface in a vacuum, the sticking coefficient must be quite close to unity. It has been indicated that errors the order of factor of 2 may result from temperature gradients within the effusion cell. The major cause of such uneven temperature distributions is the lack of radiation shielding about the cell in the region where the atomic beam extends to the collector plate. While this trouble can be corrected for low temperature measurements by proper design of the effusion cell and surrounding shielding, it will be very difficult to obviate at effusion cell temperatures above 1700°K. An upper limit has been set for the vapor-pressure of FeO(g) in the solid magnetite-liquid iron oxide region by effusion measurements. This datum has been combined with other thermodynamic data in order to calculate an upper limit to the heat of dissociation of FeO(g): $FeO(g) = Fe(g) + O(g)$; $\Delta H_0 \simeq 98$ kcal/mole. The existence of volatile iron hydroxide species was investigated by a flow method in which pure iron turnings were heated to 1628°K in a $H_2 - H_2O$ atmosphere of composition $(H_2)/(H_2O) < 0.9$, under which conditions the iron remains in the metallic state. No evidence was found for any volatile species other than Fe(g). By setting the upper limit to the vapor-pressure of an assumed FeOH(g) species as being equal to the vapor-pressure of iron at this temperature an upper limit for the D_0 of FeOH(g) is $D_0 \leq 170$ kcal/mole for the reaction $FeOH(g) = Fe(g) + O(g) + H(g)$. 14 references. (auth)

2271 The Stability of Gaseous Manganous Oxide. Leo Brewer and Donald F. Mastick. UCRL-570, Nov. 30, 1949. 9p.

The measurement of the rate of vaporization of MnO(s) at high temperatures in vacuum has been combined with available thermochemical data to yield the values for the heats of the following reactions:

$MnO(s) = Mn(g) + \frac{1}{2}O_2(g)$	$\Delta H_{298} \geq 160$ kcal/mole
$MnO(g) = Mn(g) + O(g)$	$\Delta H_0 \leq 107$ kcal/mole
$MnO(s) = MnO(g)$	$\Delta H_{298} \geq 112$ kcal/mole

Since the thermochemical value for the first reaction is $\Delta H_{298} = 160.6$ kcal/mole, the experimental measurements lead to the conclusion that the gaseous species in equilibrium with MnO(s) at 1767°K are Mn(g) and $\frac{1}{2}$ $O_2(g)$ and that MnO(g) is not an important species in the vaporization of MnO. Gaydon gives $D_0(MnO) = 92$ kcal/mole from an inspection of spectroscopic data. Comparison of this value with $\Delta H_0 \leq 107$ kcal/mole for the second reaction indicates that the upper limit set for the vapor-pressure of MnO(g) is quite high if the spectroscopic data result from the ground state of the MnO(g) molecule. This then is supplementary indication that MnO vaporizes by dissociation to the gaseous elements and that MnO(g) is not a predominate gaseous species. 11 references. (auth)

2272 The Stability of Gaseous SnO, ZnO, CdO, CuO, PbO, GeO, SiO, and TiO. Leo Brewer and Donald F. Mastick. UCRL-571, Nov. 30, 1949. 17p.

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An investigation has been made of data in the literature relative to the observed volatility of these monoxides. The results are summarized in a table and are discussed. 21 references.

2273 Method of Liquid Stabilization of Nickel Catalysts. Jacob E. Ahlberg and Clarence F. Hiskey (to U. S. Atomic Energy Commission). U. S. Patent No. 2,495,497, Jan. 24, 1950.

Stabilization of a pyrophoric reduced nickel or other metal catalysts is effected by condensing a vapor of a saturated gaseous stream or by depositing a film of liquid by direct contact on the surface of the catalyst, and then exposing the wet catalyst to the air until any desired amount of the liquid has evaporated.

2274 Determination of Oxygen in Zirconium Metal. E. B. Read and L. P. Zepatti. AECD-2798, nd, Decl. Feb. 14, 1950. 10p.

A detailed procedure is given which is based on the fact that zirconium and most of the metallic impurities may be volatilized as chlorides upon treatment with dry hydrogen chloride gas at a temperature as low as 450°C. Data are included from the analysis of a number of zirconium metal samples. Factors affecting the accuracy of the method are discussed.

2275 The Determination of Hydrogen in Sodium-Potassium Alloy by the Method of Pepkowitz and Proud. B. D. Holt. ANL-4388, Jan. 4, 1950. 22p.

Extensive, but rather unsuccessful attempts, have been made in this laboratory to apply the method of Pepkowitz and Proud (Ind. Eng. Chem. 21, 1000(1949)) to the determination of small amounts of hydrogen in sodium-potassium alloy. The procedure is as follows: a sample of the hydrogen-containing material is heated, together with a reductant such as sodium or magnesium metal, in a sealed iron capsule in an evacuated system; at temperatures in the range 600-700°C, the sample decomposes and the resulting hydrogen gas diffuses through the walls of the capsule; when a constant pressure reading is attained (usually in 15-20 min), the amount of hydrogen is measured by converting it to water over hot copper oxide, freezing out the water, and determining the change in pressures in the system; a blank value is determined on the capsule plus reductant; rather than attempt an accurate measurement of the temperature and volume of the system, an empirical constant is determined from runs on samples for which the hydrogen content is known; this constant is then used in the calculation of unknown samples. The difficulty appears to be due primarily to incomplete decomposition of some hydrogen-containing compounds at the temperatures obtained under the conditions imposed by the method. Slight modifications of the procedure did not improve the results obtained.

2276 Single Crystal X-ray Techniques for Use with Alloys Requiring Protective Atmospheres. Joseph Singer and F. H. Ellinger. AECU-711, nd. 3p.

Procedures for preparing the alloy samples in a "dry box" equipped with rubber gloves are briefly described. Inert gas flows constantly through this preparation chamber. The single crystal fragments are mounted in a capillary tube which is evacuated and sealed off.

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2277 A Rapid Calculator for X-ray Diffraction Data. H. W. Dunn. Y-556, Jan. 18, 1950. 8p.

A rapid calculator for x-ray diffraction data involving the equation $n\lambda = 2d \sin \theta$ is described. "d" is the interplanar spacing of the crystal, "θ" is the Bragg angle, "λ" is the wavelength of the radiation in angstrom units, and "n" is assumed to be 1. The apparatus consists of a number of large graphs mounted on rollers in a viewing box. The graphs are made with "θ" plotted against "d."

2278 The Crystalline Structure of the Compound $PrGe_2$. Aldo Iandelli. Atti accad. nazl. Lincei 6, 727-34(1949) (in Italian).

A complete determination was made of the lattice structure of $PrGe_2$, a compound separating, in the shape of crystalline lamellae, from a melt of both elements. In the diagram of the system Pr-Ge, this compound is the richest in Ge. The structure, belonging to the tetragonal system, is compared with that of $CaGe_2$, the dissimilarities being explained by the difference in the degree of electropositivity of Pr and Ca. This interpretation is extended to the series MSi_2 with M = Ca, Th, Ce, U, Pu (Z. anorg. u. allgem. chem. 249, 324(1942); MDDC-67).

2279 The Hydrogen Bond in Crystals. VIII. The Isotope Effect in KH_2AsO_4. D. H. W. Dickson and A. R. Ubbelohde. Acta Crysta. 3, 6-9(1950) Jan.

The axial lengths of tetragonal KH_2AsO_4 are found to be a = 7.609 ± 0.001, c = 7.148 ± 0.001 kX at 18°C. X-ray measurements on KH_2AsO_4 show that the isotope effect when deuterium is substituted for hydrogen involves a lattice expansion in the direction of the short hydrogen bonds. On the basis of certain assumptions, the isotope effect (D for H) involves an expansion of 0.0080 kX in KH_2AsO_4 which compares with 0.0097 kX in KH_2PO_4 and 0.0100 kX in $(NH_4)H_2PO_4$. (auth)

2280 Point-Focus X-ray Monochromators for Low Angle Diffraction. Jesse W. M. DuMond. Rev. Sci. Instruments 21, 188-9(1950) Feb. (Laboratory and shop note).

Two possible designs are proposed for crystal monochromators capable of producing a beam of monochromatic x-rays converging to a point. This may be accomplished by reflecting the x-ray beam successively from two crystals with cylindrica surfaces, oriented with the axes of the cylinders mutually perpendicular. It is also possible to use one crystal which has been cemented under pressure to the concave surface of a metal block having two principal radii of curvature. The author notes that such an arrangement would have many advantages over the line focussing type of monochromator proposed by Guinier (Ann. Phys. 12, 161(1939)).

2281 A Mass Spectrometer for Routine Hydrogen Isotope Analyses; Supplement No. 2. C. M. Stevens and Alfred O. C. Nier. AECD-2806, July 23, 1943, Decl. Feb. 21, 1950. 21p.

Procedures are described for mass spectrometric analysis of hydrogen gas with a high deuterium content. The position in the mass spectrometer (MDDC-197; AECD-2767) of the two collectors is such as to collect HD and D_2 simultaneously. The following are discussed briefly: design of the instrument and accuracy of analyses (resolution, memory, and water vapor effect). Some typical performance curves are included.

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2282 Deuterium Exchange in Trichlorethylene. L. C. Leitch and H. J. Bernstein. Can. J. Research 28B, 35-6(1950) Jan. (Note).

Nearly pure trichlorethylene-d can be obtained by heating sym-tetrachlorethane-d_2 with calcium deuteroxide and deuterium oxide. Other experiments to obtain trichloroethylene-d are described, but only mixtures of light and heavy form compounds were obtained.

2283 Purification of Hexadecafluoroheptane. S. Blumkin, N. C. Orrick, J. W. Grisard, and J. D. Gibson. K-557, Feb. 22, 1950. 19p.

The purification of hexadecafluoroheptane to a purity of 99.92 to 99.97 mol% by fractional crystallization followed by selective adsorption with silica gel is reported. The details and use of a constant-low-temperature bath and centrifuge for fractional crystallization are given. A 56-ft silica gel adsorption column and its operation is described. (auth)

2284 Fluorine Reactor Test. A. M. Tuholsky. K-565, Feb. 7, 1950. 14p.

The question of the behavior of insulated joints in an electrolyte recirculation system arose when consideration was being given to using such a system in the new fluorine plant. In order to ascertain if gas generation near insulated joints would occur, a test reactor was constructed to check the current-voltage characteristics of a solution of electrolyte in the presence of such an insulated joint. Results of tests to determine the current-voltage characteristics of KFHF electrolyte in the presence of an insulated joint revealed that the "local cell" action would not introduce any serious problem from the standpoint of local fluorine generation or electrical hazard in or near the insulated joint. It is, therefore, determined that the operation of a fluorine generating plant having a bank of cells electrically connected in series and using a recirculating electrolyte system will be feasible if proper sectionalizing of feed and drain headers is incorporated into the design.

2285 Stabilization of Perfluoro Oils. William B. Burford, III, and Clifford E. Weber (to U. S. Atomic Energy Commission). U. S. Patent Office No. 2,496,115, Jan. 31, 1950.

Perfluoro oils containing less than 1% of residual hydrogen are stabilized by treating with diluted fluorine, at a series of increasing temperatures starting at about 60°C and finishing off at about 300°C, preferably in the presence of an anhydrous catalyst such as cobaltic fluoride.

2286 Design of a High-Temperature Resistance Furnace. F. H. McRitchie and N. N. Ault. J. Am. Ceram. Soc. 33, 25-6(1950) Jan. 1.

An electric resistance furnace is described that is capable of operating at temperatures up to 3,770° F (2075°C) in vacuo or in hydrogen or noble-gas atmospheres. Problems of outgassing and atmosphere contamination by furnace materials are largely circumvented by eliminating insulation. (auth)

2287 Mounted Specimen. Richard S. Ringheim (to U. S. Atomic Energy Commission). U. S. Patent No. 2,494,834, Jan. 17, 1950.

A special mounting comprising in combination with a specimen of thin material to be examined under a microscope, a

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pair of reinforcing supporting members or blanks fixed to opposite faces of the specimen, the specimen and blanks being encased in a molded block of plastic that has one surface finished to expose a transverse section of the specimen for microscopic examination.

2288 The Reflecting Microscope. T. Coer. Office of Naval Research, London Branch, Technical Report No. OANAR-4-49, Jan. 21, 1949. 10p.

The reflecting microscope developed by Professor C. R. Burch, of the University of Bristol, is briefly described. This instrument has many advantages over conventional microscopes and has important applications in the biological and physical sciences. (auth)

2289 The Effect of X- and γ-rays on Aqueous Solutions of Sodium Thymonucleate. G. C. Butler. Can. J. Research 27B, 972-87(1949) Dec.

Aqueous solutions of sodium thymonucleate have been irradiated with x- and γ-rays and the effects have been assessed by measuring the changes in the viscosity of the solutions. Co^{60} and Ra were used as sources of γ rays. The relations of change produced to total dosage, to the presence of protective agents, to concentration of solution, and to dosage rate indicate that the radiations act through the mediation of activated water. The relation of change produced to the state of the nucleate before irradiation suggests that irradiation initiates, by chemical action, a process that may thereafter proceed spontaneously. (auth)

2290 The Chelation of Lanthanum with Thenoyltrifluoracetone as a Function of pH. J. F. Suttle. AECD-2800, Nov. 15, 1949, Decl. Feb. 6, 1950. 9p.

The formation of metal chelate compounds through the reaction of metal salts with β diketones has been known previously. The stability and ease of formation of the metal chelate compound is dependent upon a number of variables, and under the correct conditions this relative stability can be used in separating one element from another. The data presented here show the effect of pH and concentration on the chelation of lanthanum in a two-phase system using the same chelating agent. The distribution coefficient for the reaction was determined by use of La^{140} as a radioactive tracer. The variables changed during the reaction were: pH, concentration of La^{+3}, and concentration of thenoyltrifluoroacetone.

2291 The Isotopic Constitution of Scandium, Gadolinium, Dysprosium, Holmium, Erbium, and Ytterbium. Wallace T. Leland. Phys. Rev. 77, 634-40(1950) Mar. 1.

The relative abundances of the isotopes of scandium, gadolinium, dysprosium, holmium, erbium, and ytterbium have been redetermined with a mass spectrometer incorporating an electron multiplier to give increased sensitivity. No new isotopes were found although special attention was devoted to this problem and low upper limits were set for nearly all possible isotopes. (auth)

2292 Tenth Progress Report on Contract NObsr-39045, Covering the Period January 1, 1949, to March 31, 1949. Polytechnic Institute of Brooklyn. nd. 28p. (NP-1195).

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Solid solutions of cerium and samarium in strontium sulfide have been shown to occur to limits of 10 and 50 mol%, respectively. The trivalent ion is accomodated in the lattice by the creation of negative holes. The emission bands for the phosphor SrS-Ce containing up to 10 mol % of cerium have been determined. Further results on the distribution of europium between flux and base show that it is slightly dependent on both the concentration of europium and on the temperature. Experiments have been started to determine the effect of calcium ions on the distribution of activators. The quenching phosphors (Zn, Cd)S,Ag:Co have been investigated to determine whether changing base composition would cause a shift in the quenching bands. The location of the quenching band at 13,000 A was not affected by the addition of cadmium sulfide. The quenching and stimulating phosphor ZnS,Cu:Mn has been investigated. It was found that the green emission was more effectively quenched than the blue emission band and that there appeared to be a fairly constant ratio between the per cent quenching in the two regions. The peak of the stimulation curve in a series containing 10^{-2} gm Mn/gm ZnS occurs at about 10^{-5} gm Cu/gm ZnS. The dielectric constant apparatus has been completed and is in satisfactory operation. The sensitivity of the dielectric constant equipment is sufficient to detect a change of $\pm 0.02\mu\mu$ forads. Dielectric constant changes have been observed on singly activated ZnS,CdS phosphors and on nonoptimum infrared phosphors. No changes have as yet been detected for optimum concentration infrared phosphors. The photoconduction equipment for measurements at elevated temperatures, the equipment for thermoluminescence measurements, and the equipment for cathodoluminescence are essentially completed but are not yet operating satisfactorily. (auth)

2293 A Countercurrent Solid-Gas Fractionation Process. Allen F. Reid. AECD-2801, Jan. 7, 1948, Decl. Feb. 10, 1950. 16p.

An apparatus has been constructed for the purpose of separating mixtures of materials in the solid phase by taking advantage of the differences in the rates of sublimation and condensation of the components. The apparatus consists of a horizontally-mounted helical pyrex coil which rotates slowly on its horizontal axis and is alternately cooled and heated. Several runs were made with mixtures of benzene and cyclohexane. Results obtained with separation of carbon isotopes and of oxygen isotopes were highly satisfactory and compatible with preliminary theoretical calculations. The equipment is described in some detail, and an analysis of the process in regard to some of its possible applications is included.

2294 Distribution of Nitric Acid Between Water and Ether. J. Sutton. Atomic Energy Research Establishment Report No. AERE-C/R-438, Nov. 1949. 18p.

The solvent extraction of nitric acid from water into diethyl ether has been investigated. The stability, at room temperature, of the partition coefficient of nitric acid between water and diethyl ether, for concentrations greater than 5M in the equilibrium aqueous phase, has been quantitatively explained in terms of the distribution of nitric acid monohydrate between the two phases. The variation of the partition coefficient at lower concentrations has been similarly explained on the basis of the ionization of the

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monohydrate. Some general points concerning the effects of the various molecular species in the aqueous phase on the dielectric constant of the medium, and hence on the activity coefficients of the species in solution, are discussed. (auth)

2295 Separation of P^{32} from Neutron-Irradiated Sulfur. A. H. Booth. Can. J. Research 27B, 933-7(1949) Dec.

A method for extracting P^{32} from neutron-irradiated sulfur has been developed in which the sulfur is melted under a mixture of acetic acid and acetic anhydride at boiling temperature, and the P^{32} is recovered from the residue left after distilling the acid. An apparatus for carrying out the process by remote control is described. It has been used for production of 100 mc amounts of carrier-free P^{32} at the Chalk River laboratories. (auth)

2296 Thorium. Its Separation and Estimation. The Iodate Method. M. Venkataramaniah and Bh. S. V. Raghava Rao. J. Indian Chem. Soc. 26, 487-9(1949) Oct.

Thorium can be conveniently precipitated and estimated as $Th(IO_3)_4$ by precipitation with iodic acid. This provides also a method for separation of thorium from uranium.

2297 Variations in Absorption Spectrum of the Nitrate Group. Leonard I. Katzin. AECD-2805, nd, Decl. Feb. 17, 1950. 10p.

Lithium, magnesium, calcium, aluminum, manganous, cobaltous, nickelous, cupric, zinc, cadmium, and thorium nitrates, and nitric acid, show an absorption in tertiary butyl alcohol solution which is different from that of dilute aqueous solutions of nitrates. The most marked effects are shown by the transition elements with partially completed d shells. The variety of the spectra indicate that a single change, such as the rearrangement of the normally planar nitrate ion into a pyramidal form, cannot account for nitrate spectrum changes. 9 references. (auth)

2298 Micro-Syntheses with Tracer Elements. XVI. The Synthesis of Hexestrol Labeled with Tritium. D. L. Williams and Anthony R. Ronzie. AECU-714, nd. 15p.

Information has been desired regarding the stability of organic compounds containing the isotope tritium in place of hydrogen. Since a higher concentration of radioactivity can be imparted to an organic compound by means of tritium than with almost any other element, this method of labeling should prove to be ideal for those chemical entities which produce profound biologic changes in the living system when present in exceedingly small concentrations. A group of compounds having such an effect are the sex hormones. Minute amounts of these chemical entities can bring about deep seated physiologic changes in both the male and female. One of the female sex hormones, "hexestrol" is synthetic in the sense that it does not occur naturally in living organisms, but is a very powerful estrogen. This compound may be easily labeled with tritium and was accordingly chosen for study. Both meso- and racemic forms of hexestrol, labeled with tritium, were obtained by the hydrogenation of dienestrol with a paladium on carbon catalyst. The presence of a small amount of tritium during hydrogenation exerted a very significant influence upon the rate of consumption of ordinary hydrogen under conditions which were otherwise identical.

2299 The Action of Grignard Reagents on Diaryl Phosphinyl Chlorides. D. C. Morrison. UCRL-594, Feb. 6, 1950. 9p.

In connection with work on incorporation of radioactive phosphorus into organic molecules, it has been found desirable to study the action of Grignard reagents on the chlorides of aromatic phosphinic acids. This reaction was shown to lead to alkyl diaryl phosphine oxides. The direct replacement of hydroxyl group in a free diaryl phosphinic acid by the Grignard reagent is not feasible. The dinitro derivative of one of these phosphine oxides, not previously reported, was prepared for characterization.

2300 Alkoxy Borohydrides and their Method of Preparation. Hermann I. Schlesinger and Herbert C. Brown (to U. S. Atomic Energy Commission). U. S. Patent No. 2,494,968, Jan. 17, 1950.

Certain sodium alkoxyborohydrides prepared by reacting an alkali or alkaline earth metal hydride with certain trialkyl borates in the presence of certain solvents.

2301 The Exchange of Cl Between $AlCl_3$ and CCl_4 on the $AlCl_3$ Surface. Carol W. Herrmann and John E. Willard. AECU-721, nd. 1p.

The document is in abstract form; it is reproduced below in its entirety.

The heterogeneous exchange reaction of chlorine between $AlCl_3$ and CCl_4 using Cl^{38} as tracer has been found to proceed at temperatures as low as −21°C. with a rapid rate. The reaction appears to stop abruptly at an exchange value dependent on the temperature used (~15% at −21°C; ~40% at 25°C; 100% at 75 to 100°C). Experiments in which the average formula of the salt used is $Al(OH)_{0.25}Cl_{2.75}$ give the same results, but when the average formula is $Al(OH)Cl_2$ no reaction occurs at 0° and below although complete exchange can still be attained at 100°C.

The fact that the reaction occurs on the $AlCl_3$ surface was demonstrated by experiments in which the ratio of $AlCl_3$ to CCl_4 was varied. "Concentrations" of 10^{-5} moles per liter repeatedly gave no exchange at 100°C for 6 hr while "concentrations" of 10^{-3} m/l gave 100% exchange under the same conditions. At 10^{-5}M, the $AlCl_3$ is presumed to be completely dissolved leaving no surface on which the reaction can occur. The same behavior is found when salt of average formula $Al(OH)Cl_2$ is used.

Experiments on the homogeneous gas phase reaction gave no exchange in 4 hr at 140°C when it was certain that no solid was present.

2302 The Application of Radioactive Tracers to the Design of Distillation Columns Separating Multicomponent Mixtures. J. O. Maloney, H. E. Hughes, and Betty Seay. University of Kansas. Dec. 15, 1949. 95p. (NP-1366.)

An equilibrium still for determination of liquid-vapor equilibria is described. The still has been tested on methanol-water and ethanol-water binary mixtures, using conventional methods of sample analysis. Results have been obtained which are in excellent agreement with the generally-

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accepted values for the two systems studied. The still is sufficiently sturdy and trouble-free for use with radioactive materials, where breakage might result in laboratory contamination and hazard to operating personnel. A method has been developed for assay of radioactive carbon in volatile liquid samples. This is the only method known for quantitative counting of liquid samples containing C^{14}. A substantial reduction in the time required for sample preparation and count is achieved. The method has been applied to equilibrium determinations on the methanol-water binary mixture. Flow-type Geiger counter characteristics and typical assay results are presented. Work is progressing on the application of the above techniques to studies of multicomponent distillation. 31 references. (auth)

2303 On the Measurement of Radioactivity from Paper Chromatogram. Olov Lindberg and J. P. Hummel. Arkiv Kemi 1, 17-19(1949).

Paper chromatography is particularly suitable for experiments using radioactive tracers. By measurement of the radioactivity from a given area of the dried filter paper and estimation of the amount of the substance found on the same area, the degree to which a given component incorporates the radioactive isotope may be calculated. Since in such measurements, a filter paper of uniform thickness is always used, the internal absorption of the radiations must obviously be very constant, which renders this technique especially useful for radioisotopes with very soft emanation. On the other hand, the method requires a high specific activity in the substance to be determined, and therefore is less suitable for isolation procedures from large animals. It promises to be, however, a valuable adjunct to metabolism studies chiefly with tissue extracts, tissue culture, and Warburg experiments. (auth)

2304 Thermodynamic Studies of the U^{3+} - U^{4+} Half Reaction. Oscar A. Cook and E. D. Eastman. AECD-2803, Sept. 1944, Decl. Feb. 7, 1950. 9p.

Experimental electromotive force measurements have been made to obtain thermodynamic data for uranium chlorides. The results are discussed in regard to interpretation and reliability of the data.

2305 The Determination of Uranium by Potentiometric Titration with Ferric Sulfate. W. R. Grimes. AECD-2804, Apr. 1, 1947, Decl. Feb. 8, 1950. 35p.

Titration of uranium with ferric sulfate through the U(III)-U(IV) and U(IV)-U(VI) potentiometric end points has been shown to be a rapid and accurate method of determination of this element in solutions free from interfering ions. Reduction of uranium in acid solution by passage at room temperature through a Jones reductor suffices to give a mixture of trivalent and quadrivalent uranium for the titration. The titration is best conducted by addition of ferric sulfate in 5% (by volume) sulfuric acid to the reduced uranium in acid of the same composition maintained at 92 ± 2°C under an atmosphere of CO_2. The calomel-platinum electrode system has been shown to be satisfactory for the emf measurements. Addition of 0.10 g of chromium as $Cr_2(SO_4)_3$ in 5% H_2SO_4 solution to the reduced solution provides a more reproducible first end point. By use of these conditions titrations which are accurate within ±0.1% may be made at the rate of 2 - 3 per hr by an experienced analyst. The titration may be conducted by addition of ferric sulfate in 10% (by volume) $HClO_4$ to uranium in this medium or by addition of ferric chloride in 20% HCl to an HCl solution of uranium under the conditions described for titration in H_2SO_4 at some expense in accuracy. Nitrate, fluoride, and large amounts of phosphate (more than 0.5 g PO_4^{-2}/0.5 g U) interfere with this method of determination although repeated evaporation of the solution to fumes of SO_3 is sufficient to remove the first two listed. Iron, chromium, nickel, cadmium, manganese, and aluminum do not interfere with this determination. Vanadium, molybdenum, tungsten, copper, and tin interfere in various ways and must be removed, with the exception of vanadium whose interference is stoichiometric and may be corrected after separate determination of this element. Titanium introduces a third end point but no error results if all three are detected and the titer between the last two assumed to be equivalent to the uranium present. Application of the method to analysis of pure uranium compounds and to uranium recovered from contaminated solutions by suitable procedures is briefly discussed. 21 references. (auth)

2306 Volumetric Determination of Small Amounts of Uranium (Chromous Chloride as Reducing Agent). William D. Cooke, Fred Hazel, and Wallace M. McNabb. Analyt. Chim. Acta 3, 656-9(1949) Dec.

A volumetric method is proposed for the rapid determination of small amounts of uranium. The hexavalent uranium is reduced to the quadrivalent state by chromous chloride, the excess of which is destroyed by air oxidation. Phenosafranine, a low potential redox indicator, is used to follow the reduction and air oxidation. Ferric sulfate is added to the solution and the resulting ferrous ion titrated with dichromate solution.

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2307 Nut and Bolt Loading Curves. C. P. Coughlen. ORNL-578, Feb. 15, 1950. 55p.

Tests of nut and bolt sets were made wherein the bolt loads resulting from controlled torques applied to the nuts were measured. Torques were applied using calibrated torque wrenches. Loads were measured by a Tate-Emory Universal Testing Machine in which the specimens were mounted. Metals of construction, bolt sizes (½ in. to 1⅛ in.), and thread surface conditions were varied. Normalized curves are presented. Included as appendices are: (1) a table of comments on certain irregularities noted during the test work; (2) a table listing qualitatively the shift in the loading curves on the second run-down; and (3) a reprint of an analysis of the data (by R. Van Winkle) that was included in a memorandum of very limited distribution. The analysis includes some additional data developed by Van Winkle. (auth)

2308 Packless Valve. Jesse B. Thomas (to U. S. Atomic Energy Commission). U. S. Patent No. 2,495,081, Jan. 17, 1950.

A double seal valve includes a valve casing having a streamline interior passage and a mechanically expanded double valve head structure within the passage. The valve head is manually operable to close the passage at two points

to prevent the leakage of fluids through or into the valve. An arrangement of sealing fluids under pressure and of bellows type seals provides a leakproof packless structure for controlling the flow of gases and/or liquids.

2309 Heat Transfer by Natural Convection from Horizontal Cylinders to Liquid Metals; Progress Report for July 1, 1949, to September 30, 1949. Seymour C. Hyman and Charles F. Bonilla. NYOO-77, Sept. 30, 1949. 10p.

Data have been obtained for free convection heat transfer to water, toluene, and mercury from a horizontal cylinder approximately ½ in. in diameter in both viscous and eddy current regions. The results definitely deviate from previous correlations. Interpretation of these results and modification of the current standard correlation will be attempted when additional fluids have been tested. (auth)

2310 Rubber Tubing Pump. John W. Weigl and Donald W. Stallings. UCRL-562, Jan. 3, 1950. 4p.

A brief description and photograph of a rubber tubing pump to be used for gas circulation in the laboratory is presented. The speed may be controlled from about 100 to 1500 cc/min by means of a set of step pulleys, as well as by adjustment of the hinged tubing race, and by changing the size of tubing used. The main virtues of this type of circulating pump are the smooth flow and negligible hold-up, the lack of metal parts and lubricant in contact with the gas, its rugged construction and ability to withstand evacuation without leakage around shafts and bearings. It may be used for pushing or re-cycling gas, or for the well-controlled evacuation of a closed system to less than 1 mm pressure.

2311 Diffusion Pump. Glenn R. Stoltenburg (to Atomic Energy Commission). U. S. Patent 2,489,058, Nov. 22, 1949.

This device consists of a diffusion pump with improved nozzle design. The nozzle is so constructed as to give the expanding vapor a velocity component in the direction of the axis of the pump, which must be overcome before the oil can diffuse back into the exhausted member. Other changes in the jet increase the density of the vapor stream, increasing the efficiency of operation against high exhaust pressures. The nozzle is also somewhat shorter than the conventional design, and the power requirements are therefore lower. Provisions are also made for removing sediment from the oil before it enters the high vacuum system.

2312 Investigation of the Glass Structure Using Radioactive Tracers. Henry H. Blau and James R. Johnson. Glass Ind. 30, 393-4(1949) July.

A new fundamental knowledge of glasses and the vitreous state is possible by the use of radioactive tracers. The rate of diffusion of an ion in glass at any particular temperature can be followed by using Na^{24} as a tracer. The diffusion rate depends on the energy required to move the ion from one equilibrium position in the structure to the next. The energy in turn is dependent on the ion bond energies, ion sizes, interionic distances and interstices in the structure. It is believed that from the energy of activation, an explanation can be found regarding the characteristic random structures of glasses as well as the viscosities and strengths of glasses.

2313 Measurement of Wall Thickness. Gerhard Herzog (to The Texas Co., New York, N.Y., a Corporation of Delaware). U. S. Patent 2,486,845, Nov. 1, 1949.

The inventor has devised a means for measuring the thickness of walls by measuring the intensity of a beam of γ rays transmitted through the wall. Under certain circumstances it may be difficult to find the point on the wall directly opposite to the source of the radiation. In this case a small detector may be used to locate the point of maximum intensity of the radiation, and the radiation intensity may then be measured with a detector having a larger sensitive area. The sensitive area of a large detector may also be cut down for this purpose by the use of a lead absorber in the shape of a ring.

2314 Radiochromium Plating for Friction Studies. John T. Burwell and S. F. Murray. Nucleonics 6, 34-7 (1950) Jan.

The object of this study was to determine to what extent sliding friction is due to the making and breaking of minute adhesions or "welds" between the two surfaces involved. For this purpose, piston rings were coated, by a chemical process described in the article, with radiochromium obtained from Oak Ridge. After a period of normal operation, the piston rings were removed and a photographic plate was inserted into the cylinder. Areas of exposure appeared on the film, indicating that chromium had been transferred to the steel barrel. This chromium was not wiped off when the barrel was scrubbed with a solvent before exposure.

2315 The Use of Radioactive Tracer Isotopes in the Rayon Industry. Paul Warner Frisk. Rayon and Synthetic Textiles 31, 39-41(1950) Jan.

The author discusses some possible uses of radioactive isotopes in the rayon industry. The tracers discussed are S^{35} and radioactive lead isotopes. The application of S^{35} as carbon bisulfide to follow the various steps in the Xanthate process is described. The use of lead tracers to study the effect of soluble lead salts in the spinning bath is briefly presented.

2316 Vacuum Analyzer. John G. Backus (to U. S. Atomic Energy Commission). U. S. Patent Office No. 2,499,288, Feb. 28, 1950.

This vacuum analyzer is of the mass spectrometer type and is so constructed as to be able to operate over a wide range of pressure to indicate the components of the atmosphere in which it is operating.

2317 Vacuum-Tight Seal of Glass and Mica. Jacques Labeyrie. J. phys. radium 11, 20(1950) Jan. (in French).

Thin sheets of mica (down to about 0.01 mm) can be sealed to glass by the use of a powdered enamel which melts at 550° and softens at 354°. The same enamel may be used to seal mica to a metal with a coefficient of expansion between 85 and 110×10^{-7}. (auth)

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2318 Apparatus for Detecting and Measuring Radiant Energy for Locating Subterranean Petroleum Deposits. Walter Armstrong. Canadian Patent 460, 656, Nov. 1, 1949.

An apparatus for detecting the radiant energy emanating from subterranean petroleum deposits is described. It consists of an ionization chamber entirely enclosed in a protective shield except for a portion between the ionization chamber and the earth's surface; the opening is made essentially impervious to earthly ionizing radiations. The ionization chamber contains means for determining the rate of dissipation of the charge on the inner surface of the chamber and for comparing it with the rate of dissipation of a similar negative electrostatic charge when shielded from the radiation encountered in the petroleum deposit. A microscope extends through one side of the surrounding shielding and is used for determining the relative amount of the radiant energy emanating from subterranean petroleum deposits and penetrating the shielding.

2319 Lead Isotopes and the Age of the Earth. Harold Jeffreys. Nature 164, 1046-7(1949) Dec. 17. (Letter to the editor). (See also NSA 2-481.)

The author's analysis of the method of estimating the age of the earth's crust (Nature 162, 822(1948)) from lead isotope ratios has been attacked by Holmes (Nature 163, 453 (1949)). It is noted that the same difficulties which Holmes points out persist in later work by other authors (Houtermans, Z. Naturforsch. 2a, 322(1947)). These difficulties are discussed and it is noted that Holmes' criticisms, while partly justified, are partly based on misinterpretation of the author's work.

2320 New Logging Method. Charles J. Deegan. Oil Gas J. 48, 23(1950) Mar. 2.

A new radio-active well-logging method has been developed by Perforating Guns Atlas Corp. of Houston, Texas. With the new method it is possible to obtain both a γ ray and a neutron log without increasing the cost of drilling rig time over that now required by conventional radioactive methods to obtain a single log. The γ-ray log result measures the natural γ-ray emissions from the formations in the well. This is the same in both new and conventional methods. The neutron-log recording device of the new system measures slow neutrons only. The source of radiation for bombardment of the formation is relatively free of γ rays. Radiation is obtained by using a polonium-beryllium combination.

2321 The Radioactivity of Sediments (3) Determination of Rock Absorption Coefficients. E. N. Tiratsoo. Petroleum 12, 166-9(1949) July.

The author discusses the general nature and properties of γ rays, derives the exponential absorption law and gives absorption coefficients for several elements and several γ-ray energies. Results of several previous measurements of the absorption coefficients of geological specimens are cited. Only γ rays are considered because alphas and betas are very quickly absorbed. The experimental technique used by the author is outlined, and absorption coefficients, calculated from data obtained by the author, are listed for several types of sandstone, shale, marl, and limestone. A pitchblende source was used in these measurements, and the calibration of the source is described.

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2322 Well Logging. Lynn G. Howell (to Standard Oil Development Co., Delaware). U. S. Patent 2,474,581, June 28, 1949.

This invention is an improvement and continuation in part of U. S. Patent 224,304 (Aug. 12, 1938) relating to the use of Geiger-Mueller counters to measure the radioactivity of the geologic layers traversed by the bore hole. It is here proposed to use two or more counters in spaced relation to each other for well logging. In this way spurious indications peculiar to one device are not reproduced in the other, and significant counts can be distinguished. Moreover, a plurality of records free from depth measurement error are obtained. Finally, a plurality of records is produced with the same travel rate of the detector.

2323 An Investigation of Melting and Casting Procedures for High Purity Nickel. Douglas W. Grobecker. AECU-712, nd. 38p.

A suitable melting practice for the production of high purity nickel castings has been developed as follows: electrolytic nickel and returned scrap were melted in a monolithic sillimanite-lined induction furnace; nickelous oxide was added during the melt-down to provide a strongly oxidation condition during the initial stages of the melting cycle; carbon was added when the desired temperature was reached to cause a vigorous boil and begin deoxidation; small amounts of manganese and aluminum were added to further deoxidize the nickel; magnesium as a final addition was used to kill the heat; and the metal was poured immediately after the magnesium addition. Returned scrap was used as a part of the charge for most of the melts. Nickel machine turnings, after suitable processing, were remelted as portions of charges. Pouring temperatures were critical. Mold feeder head insulators were found to be necessary. The mold materials tried were graphite, uncoated and coated with a fired magnesia wash; compacted carbon; core sand; and dry sand (air dried, skin dried, and oven dried). The cast nickel showed some tendency toward intergranular weakness, but not sufficient to prevent the production of the desired castings. Photomicrographic studies indicated that some gas was retained in the cast metal. Nickel castings were obtained with purity as high as 99.0% nickel and free from defects when radiographically inspected. 12 references. (auth)

2324 Thermal Stresses in Beryllium. H. C. Savage. ORNL-571, Feb. 9, 1950. 20p.

A previous investigation of the thermal stresses in beryllium cylinders (ORNL-73) did not produce stresses large enough to cause failure of the beryllium. In addition no attempt was made to measure the temperature drop through the metal and the physical properties of the pieces tested were not known. The purpose of the present investigation was to obtain more complete information and to test the pieces to failure. Thermal stresses produced experimentally in various specimens of beryllium cylinders were large enough to cause failure. Experimental results compare with theoretical calculations which may be used to determine expected thermal stresses in beryllium where the heat flow and geometry of the material is similar to the case presented in this report.

2325 Self-Diffusion of Metals and Associated Phenomena. B. H. Alexander, M. H. Dawson, H. P. Kling, G. C.

Kuczynski, and F. D. Rosi. SEP-30, Dec. 15, 1949 69p.

This report covers progress for the period April 1 to October 1, 1949. The bonding of copper wires to copper plates has been studied at temperatures approaching the melting point, and the results are explained in terms of self-diffusion. A study of the bonding of dissimilar metals has shown some striking examples of nonsymmetrical diffusion junctions. The possible influence of this effect on some industrial problems is indicated. An attempt to follow the movement of fiducial markers in diffusion couples has shown that relatively large movements may be caused by changes in atmosphere and by thermal cycling. The sintering of ionic crystals was studied, but no conclusions as to the mechanism could be ascertained. An investigation of the creep of gold wires at high temperature has shown that under small stresses a Newtonian viscous flow is exhibited. The viscosity coefficient of gold was found to be 2.4×10^{12} poise at 970°C. A new method for detecting microslip by means of a piezoelectric crystal has been found to be promising in the study of plastic flow of metals. The studies being carried out on high temperature creep and on recrystallization and grain growth of metals are outlined. 13 references. (auth)

2326 Forging and Welding Titanium. L. B. Frazier. Iron Age 165, 63-7(1950) Jan. 19.

A discussion is given on the forging and welding of titanium. The metal is readily forged at temperatures from 1,600 to 1,800°F. Above 1,850°F, the danger of gas absorption causing rough surfaces is considerable. Below 1,500°F the metal not only becomes harder to forge but it also shows signs of cold work after cooling. Titanium metal exhibits poor cold swaging properties. This is due to its excessive work-hardening characteristics which result in the cracking or breaking of many parts. In the welding of titanium the spot welding, seam welding, inert-arc welding, and resistance welding processes are described. Titanium welds sustain satisfactory loads. However, when sufficient loading has been applied to cause permanent deflections, incipient cracks are discerned along weld boundary and the parent metal. Welds made by the inert-arc process are strong but brittle at the fusion zone. A brief mention is made of the successful cutting of titanium by the oxyhydrogen process.

2327 Investigation of Possible Improvements in the Production of Zirconium Metal; January 1 to January 31, 1950. Stephen M. Shelton. Bureau of Mines Summary Report No. 7, Feb. 14, 1950. 8p. (NP-1394.)

The purpose of this project is to investigate on a small scale possible improvements in the Bureau of Mines zirconium process which might be adopted in the pilot plant to increase production and purity of the metal. This report deals with two separate experiments testing two materials of construction that have been suggested as lining for the reaction pots in the present zirconium process. A graphite-lined pot has been used successfully on a small scale in the laboratory without any appreciable carbon pick-up by the zirconium during the reduction and distillation stages of the process. The sponge can be readily removed from the graphite-lined pot without destroying the lining. In a larger scale operation, this may prove to be impracticable because

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of the larger masses of sponge to be handled. There was no pyrophoric layer between the sponge and the graphite lining. Large scale tests should be made to show any advantage that a graphite lining might have over cast iron pots previously described and now undergoing repeated tests in the large pilot plant. A zirconium-lined pot was tested and the results obtained were definitely negative.

2328 Powder Metallurgy; Review of Progress during 1949. R. A. Hetzig. Metallurgia 41, 88-90(1949) Dec.

The general position of powder metallurgy in regards to other metallurgical processes is briefly mentioned with a discussion on the following applications: magnetic, gas turbine blades, high melting point alloys, hard metal, diamond tools, and miscellaneous applications. A brief presentation is made of the theories of pressing and sintering.

2329 Producing Beryllium Fluoride. Warren S. Peterson and Charles B. Willmore (to the Aluminum Co. of America, Pittsburgh, Pa.). U. S. Patent 2,487,270, Nov. 8, 1949.

This invention describes a process for the conversion of beryllium ores such as beryl to beryllium fluoride and is not particularly concerned with after-treatments employed for separating beryllium fluoride from other materials or for reducing beryllium fluoride to metallic beryllium. The process is continuous and consists of charging the ore into a conversion chamber after first smelting with carbon and iron, eliminating silica at 600 to 700°C in one part of the chamber, and passing hydrogen fluoride through the ore while the other part of the chamber is maintained at 450 to 500°C; the BeF formed is continuously drawn off.

2330 A Study of Some Alloys of Titanium. W. E. Kuhn, H. V. Kinsey, and O. W. Ellis. Can. Mining Met. Bull. 43, 74-87(1950) Feb.

The binary titanium alloys containing up to 10% of the elements chromium, cobalt, iron, manganese, molybdenum, nickel, and tungsten have been investigated and the results described. The alloys were produced by powder metallurgy methods and three different sintering temperatures were tried, namely, 1100, 1200, and 1300°C. The results are presented in tabular form. Several tables of mechanical properties are presented and discussed. The oxidation resistance of titanium and various titanium alloys is described. The metallography of the binary alloys is presented and photomicrographs of each alloy is shown both in the as-forged condition and after annealing at 732°C for 1,000 hr.

2331 On the Use of Photographic Emulsions for the Determination of Radioactivity of Rocks by the Examination of the Trajectories of α Rays. R. Coppens. J. phys. radium 11, 21-32(1950) Jan. (in French).

The author describes the use of photographic plates for determining the uranium and thorium content of rocks. By this method he evaluates the ratio of thorium to uranium concentrations, and the total radioactive content of several rocks found in Brittany. The radioactive material was found to be distributed in the following way: in very small inclusions (with areas measured in tens of square microns); in crystals as large as 1 mm containing thorium (1 part in 100) very unevenly distributed, with little or no uranium; in

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small grains (several hundreds of square millimeters) with high thorium concentration (75 parts in 100), possibly in the form of pure thorite. (auth)

2332 Note on the Fluorescence Test of Bentonite. Yi Hseung and C. C. Yeh. Am. Mineral. 34, 896-7 (1949) Nov.-Dec.

In differentiating between swelling and nonswelling bentonites containing sodium ions, both materials are first moistened with zinc uranyl acetate and then they are subjected to ultraviolet light. The swelling bentonites fluoresce under the light whereas the nonswelling bentonites fluoresce only slightly, or not at all. The fluorescence reaction is due to the precipitate of the triple salt sodium uranyl zinc acetate having the composition $Na(UO_2)_3$ Zn $(CH_3COO)_9 \cdot 6H_2O$. When the sodium content is less than 0.2%, there is no fluorescence. Feigl (Rec. trav. chim. 58, 473(1939)) reported 2.5 γ as the limit of identification of sodium by the fluorescence test.

2333 The Adaptation of Tracer Techniques to Mineral Engineering Problems. A. M. Gaudin and H. R. Spedden. MITS-5, Jan. 31, 1950. 16p.

Progress is reported on the following research topics: synthesis of S^{35} - marked sulfide minerals; chemical activation in flotation; geochemical studies; kinetics of surface reactions in flotation; synthesis of C^{14} - labeled dyes; surface measurement; flotation with volatile reagents; neutron activation of ores for picker belt separation; adsorption of dodecylamine acetate on hematite; depression of pyrite in flotation.

2334 Radioactive Tracer Methods Applicable to Ceramic Research. James R. Johnson. Am. Ceram. Soc. Bull. 29, 16-19(1950) Jan.

A brief nonmathematical survey of the basic principles of radioactivity and general physical and chemical properties of radioisotopes is given as a background. A discussion of instruments and methods for measuring the decay of radioisotopes is presented with a few ceramic research applications, including possible schemes of radioassay which are given for consideration.

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2335 Physics Division Quarterly Progress Report for Period Ending December 15, 1949. A. H. Snell and E. O. Wollan. ORNL-577, Feb. 8, 1950. 46p.

Gamma Rays of K^{40}. The scintillation spectrometer has shown that K^{40} emits a γ ray of energy 1.45 Mev, and that positron emissions to A^{40} amount to less than 1% of the K-captures. Metastable Level in Au^{197}. A new metastable level in Au^{197} has been found. The associated half-life is 7×10^{-9} seconds. This is a record for rapidity of a measured radioactive decay, and the fact that the decay curve is exponential over a factor of 100 is a tribute to the quality of the scintillation techniques used for measuring these extremely short time intervals. The energy resolution of the scintillation spectrometer has permitted the separate observations of the energies and K/L ratios of the converted radiations (1) preceding the formation of the 7×10^{-9} sec level, and (2) accompanying decay from the 7×10^{-9} sec level. The former is marked by the unusual occurrence of

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a K/L intensity ratio as low as 0.1. Linearity of Scintillation Spectrometer. Monoenergetic electrons were shot into an anthracene crystal, and it was found that the photomultiplier pulse height was quite accurately proportional to electron energy in the range 150 to 700 kev. Below 150 kev the results are confused by window absorption. The measurements will be extended above 700 kev. Scintillation Counting of Slow Neutrons. Attempts are being made to develop a suitable phosphor for this purpose. Scintillation Spectrometry of Short-Lived Activities. By displaying the output pulses from a scintillation spectrometer on an oscilloscope screen, and by photographing the resulting multisweep patterns, it has been found possible to register β- and γ-ray energy spectra in a striking and revealing way. The technique has distinct advantages over conventional methods when applied to short-lived activities. The γ rays associated with the 1-sec lead and the 24-sec silver activities have been measured for the first time. Thermal Neutron Capture Cross Sections. The accumulated results of the capture cross sections of 69 elements, as determined with the pile oscillator, are presented. Neutron Decay Experiment. Subsidiary experiments on the behavior of the β counter-multiplier coincidences have led to the conviction that they must be β-proton coincidences associated with radioactive decay of the neutron. Solid State Physics. Construction of the new Hot Laboratory for the Radiation Damage work is expected to start momentarily. Germanium Irradiation Meter. Experiments are continuing on the use of germanium rectifiers for the purpose of measuring accumulated neutron irradiation. The conductance in the forward direction has been found to decrease over a time interval of several days when the rectifier was in a low-flux region of the pile. Theoretical Physics. Preparation of the L-shell internal conversion coefficient calculations has been completed, and the work has been sent to the Computation Laboratory of Harvard University. Van de Graaff Program. The design of the High Voltage Laboratory Building at ORNL has been brought to the point of formulation of a construction request. Unfortunately, the detailed cost estimate turned out to be higher than expected, and this has necessitated a re-evaluation of the Y-12 site. (auth)

2336 Thermal Flame Propagation. Howard W. Emmons, John A. Harr, and Peter Strong. HUX-9, Dec. 1949, 33p.

The propagation of combustion reactions are considered in the simplest possible case. Former authors considering this case have approximated solutions to the nonlinear differential equation which have unavoidably lost some necessary parts of the propagation phenomenon. In this paper the nonlinear equations are solved numerically, and these solutions show that in a strict mathematical sense a "flame speed" does not exist. It shows further that with certain restrictions a "flame speed" does exist, but that the manner in which these restrictions are actually satisfied experimentally is not yet clear. (auth)

2337 Summary of the Research Progress Meeting of October 20, 1949. H. P. Kramer. UCRL-548, Dec. 12, 1949. 8p.

The following topics were reviewed: meson production (artificial); charge increase of III in the bombardment of tin with protons and α particles.

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2338 Summary of the Research Progress Meeting of Dec. 8, 1949. H. P. Kramer. UCRL-559, Dec. 29, 1949. 13p.

The following topics were reviewed: destructive action of astatine upon the thyroid; showers induced by 335-Mev bremsstrahlung; progress report on the 60-in. cyclotron.

2339 Summary of the Research Progress Meeting of October 27, 1949. Henry P. Kramer. UCRL-564, Jan. 25, 1950. 6p.

The following topics were reviewed: excitation functions of arsenic and manganese; irradiation of micro-organisms with deuterons and α particles.

2340 Summary of the Research Progress Meeting of December 15, 1949. H. P. Kramer. UCRL-566, Jan. 25, 1950. 8p.

The following topics were reviewed: electron showers from synchrotron - theoretical interpretation; low mass francium and radon isotopes of high α stability.

2341 The Sticking Coefficients of Carbon and Iron Atomic Beams. Leo Brewer and Donald F. Mastick. UCRL-572, Nov. 1949. 23p.

The accurate determination of the vapor-pressures of the elements is of great importance in the establishment of their thermodynamic properties. Two methods which are capable of yielding accurate results in the low pressure range are the effusion method and the measurement of rates of vaporization from a free surface in a vacuum. In considerations of the equilibrium between a gaseous and condensed phase a factor α, the sticking coefficient, must be considered, such that if p is an apparent vapor-pressure which determines the rate of evaporation from a surface, and if p^0 is the equilibrium vapor-pressure, then $p = \alpha p^0$. This means the atoms in the gas phase do not have unit probability of condensing upon striking the surface if α is not unity and that the rate at which atoms enter the gas phase is proportional to p rather than to the equilibrium pressure p^0. The factor α may also be expressed as a fraction of the number of gaseous atoms which strike unit surface per unit time that condense. The vapor-pressures of many of the refractory metals have been measured by either of these methods, both of which are subject to error if the sticking coefficient is not close to unity. Furthermore, essentially only one measurement has been made previously to determine these sticking coefficients to test the validity of the reported vapor-pressures. The sticking coefficient of atomic beam carbon atoms issuing from an effusion cell at 2760°K on a deposit at 900°K has been found here to be 0.45. Since this measurement was conducted under essentially the same experimental conditions as used by Brewer, et al (J. Chem. Phys., 16, 797(1948)) in the determination of the heat of sublimation of graphite, the factor $\alpha = 0.45$ may be applied directly to their data. A measurement is also reported for the sticking coefficient of atomic beam iron atoms on the collector plate, the value being $\alpha = 0.98$. It is concluded that the sticking coefficient is essentially unity at the temperature of the iron surface during the vaporization measurement. 20 references.

2342 German Physical Society. Meeting held on April 22-24, 1949, at Hamburg. Angew. Chem. 62, 45-9 (1950) Jan. 21 (in German).

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Among the papers presented were the following: The Construction of a Mass Spectrometer with Velocity and Directional Focussing, R. Kollath and D. Fischer; The Influence of Magnetic Fields on the Velocity of Diffusion in Oxygen, H. Senftleben and H. Schult; Slowing Down and Diffusion of Cosmic Ray Neutrons in the Atmosphere, E. Bagge and K. Fincke.

2343 Nuclear Physics Research at the University of Basel. Paul M. Marcus. Office of Naval Research, London Branch, Technical Report No. OANAR-56-49, Dec. 23, 1949. 8p.

The staff, equipment, and current research in nuclear physics at the University in Basel, Switzerland, is briefly reported. The Physical Institute, under the direction of Professor Paul Huber, with a staff of two other professors and a dozen younger men, has developed work in this field on a modest scale in the last ten years. The work centers around the operation of a 200-kv Cockcroft-Walton apparatus used for protons and deuterons, and the construction of a 1.2 Mev Cockcroft-Walton, which is about completed. Much work has gone into the development of counters, counting circuits, pulse spectrum analyzers, electron multipliers, ionization chambers, scintillation counters, and associated electronic equipment. Among the studies which have been made are nuclear resonance reactions, the energy required to produce an ion pair in an ionization chamber, and γ-γ and β-γ correlations in radioactive decay. (auth)

2344 The Two Fluid Model for Helium II. C. J. Gorter. Nuovo cimento 6, Sup., 245-50(1949).

If Gibbs' function G for a mixture of two fluids is not linear in the concentrations, Gibbs' phase rule does not apply. G may then be considered a function of the temperature, the pressure and the relative concentration of the normal fluid. Certain information about the form of this function may be deduced from the anomolous behavior of He II. This paper is one of a series presented at the International Conference on Statistical Mechanics at Firenze in May 1949. The reading of the paper was followed by a discussion period on the general theory and anomolous properties of He II; a transcript of this discussion follows the article.

2345 Production Cross Sections for Positive and Negative π-Mesons by 345-Mev Protons on Carbon at 90° to the Beam. C. Richman and H. A. Wilcox. UCRL-592, Feb. 2, 1950. 9p.

A photographic emulsion method has been developed for measuring the absolute production cross sections for positive and negative π-mesons when various kinds of nuclei are bombarded with high energy charged particles from the Berkeley 184-in. synchro-cyclotron. The method is described and its application to the positive and negative π-meson production by high energy protons on carbon is studied. The differential cross sections obtained are plotted as a function of the energy of the mesons.

2346 The Angular and Lateral Spread of Electrons in a Shower. I. A. Borsellino. Nuovo cimento 6, 543-51(1949)(in Italian).

An evaluation is made of the mean square angular and lateral spreads of electrons in a shower, for energies suf-

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ficiently high with respect to the critical energy, i.e., with the approximation "A" of Rossi and Greisen (Rev. Modern Phys. 13, 262(1941)). The numerical results of the calculation are confronted with those given by Molière (Z. Physik 125, 250(1949)) and by Roberg and Nordheim (Phys. Rev. 75, 444(1949)). (auth)

2347 The Capture of Mesons. Part II. B. Bruno. Arkiv Fysik 1, 19-39(1949). (See also NSA 4-181.)

The results of a preceding paper (Bruno, Arkiv Mat. Astron. Fysik 36 A, No. 8 (1948)) are applied to the process $\pi^- + P \rightarrow N$. The modifications necessary when passing over from a meson mass of about 200 m_e to $m_\pi \approx 285\ m_e$ are discussed. The α-particle model of the nucleus is used and special attention is paid to final states implying a total disruption of the α-particle, as these will gain in importance with increasing mass of the meson. The calculations refer to the capture of slow mesons. Because of the great uncertainty of the estimate of the probability of the process, a comparison with the probability of radiative capture ($\pi^- + P \rightarrow N + h\nu$) is made. Since the frequency of stars at the end of π^--meson tracks indicates that the former process dominates, a lower limit of this is thus assumed to be obtained. The limit seems, however, to be somewhat too high to be in good agreement with the estimated probability of capture without photoemission. It is further shown that the influence of the nuclear bindings cannot be neglected when evaluating the probability of radiative capture, but can—except for the case of scalar mesons—be roughly accounted for by the factor $1 - e^{-\frac{k^2}{16\mu_\alpha \hbar^2}}$, where k is the momentum of the emitted photon and $1/\sqrt{\mu_\alpha} \approx 3.7 \times 10^{-13}$ cm. In the case of the capture of a slow π-meson the factor is about ½. General arguments are given for the use of the α-particle model when a slow meson is captured or produced.

2348 Cosmic-Ray Underground. I. Satio Hayakawa and Sin-itirô Tomonaga. Progress Theoret. Phys. 4, 287-96(1949) July-Sept. (See also NSA 3-360.)

A theoretical discussion is given of the depth intensity curve of the cosmic radiation. It is shown that the experimental values of Wilson (Phys. Rev. 53, 337(1938)) and Nishina et al (Phys. Rev. 59, 401(1941)) lie between two theoretical curves, one neglecting the absorption of π mesons, the other assuming for their absorption coefficient the same value as for nucleons. The authors conclude, moreover, that no processes other than electromagnetic ones are needed to explain the experimental evidence concerning the absorption of the cosmic radiation.

2349 Cosmic-Ray Underground. II. Satio Hayakawa and Sin-itirô Tomonaga. Progress Theoret. Phys. 4, 496-501(1949) Oct.-Dec. (See also NSA 3-360.)

Previously the authors have treated the intensity of the cosmic radiation below ground by considering the electromagnetic interaction of the μ mesons with matter (Progress Theoret. Phys. 4, 287(1949)). To make sure of the validity of the assumption that the soft component and showers occurring at great depth below ground are mainly produced by the electromagnetic interaction of μ mesons with matter, a calculation was made of the number of electrons and showers accompanying a μ meson, taking into account knock-on processes, energy loss by radiation, and pair creation for a Dirac particle. Comparison with the pertinent experiments is difficult since they are largely inconsistent among themselves. The authors believe the data of Wilson and Hughes (Phys. Rev. 63, 161(1943)) to be most reliable. They are in fair agreement with the calculations of the authors.

2350 Emission of Protons and Alpha-Particles in High Energy Cosmic Ray Stars. D. H. Perkins. Phil. Mag. 41, 138-43(1950) Feb.

This paper describes measurements of the energy, angular, and frequency distributions of protons and α particles in disintegrations of the silver and bromine nuclei of nuclear emulsions, at excitation energies comparable with and larger than the binding energy (~700 Mev). Only those charged particles with ionization greater than six times minimum have been considered (i.e., greater than that of a 50-Mev proton). The star disintegrations were observed in Ilford C2 plates, 100 thick, exposed at Jungfraujoch (3457 m). (auth)

2351 Energy Distribution in Particles Emitted During Nuclear Evaporations. G. Cortini. Nuovo cimento 6, 470-83(1949)(in Italian).

A method is given for the determination of the energy distribution in the star prongs. Unlike the usual procedures using grain counting, the present method is based on the measurement of the lengths of the track projections. Statistical results of an examination of about 4,000 stars, produced by cosmic rays at 3,500 m altitude are presented, such as energy spectra of protons and α particles of stars, and the calculated and observed numbers of prongs. (auth)

2352 Fluctuations in Proportional Counters. W. F. G. Swann. J. Franklin Inst. 249, 133-7(1950) Feb.

It has been reported by many workers that a cosmic ray particle traversing similar path lengths in two proportional counters often gives pulses of appreciably different amplitude. The path lengths may be quite long, so that the primary may produce about 300 primary ionizing events in each counter. The author carries out a statistical study of the secondary electrons produced in primary ionizing events, and shows that the total ionization current in the counter is largely due to a small number of high energy secondary electrons. Statistical variations in this small number may cause large variations in the output pulse.

2353 Mesons Produced by the Cyclotron. Eugene Gardner, Walter H. Barkas, F. M. Smith, and Hugh Bradner. Science 111, 191-7(1950) Feb. 24. (See also AECD-1846 and NSA 4-1995.)

The authors discuss the use of photographic plates in the study of mesons produced by the 184-inch Berkeley cyclotron. The masses of the π and the positive μ meson were determined by deflecting the particles in a magnetic field, with the following results; $m_\pi = (276 \pm 6)\ m_e$, $m_{\mu^+} = (210 \pm 4)\ m_e$. The lifetime of the π meson was measured by means of an experimental arrangement described in the article, and the results for negative and positive mesons do not agree. A statistical study was made of the number of prongs in the emulsion stars produced by mesons. The prong distribution is tabulated. The article concludes with an extensive bibliography.

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2354 Moderation of Negative Mesons in Hydrogen I: Moderation from High Energies to Capture by an H_2 Molecule. A. S. Wightman. Phys. Rev. 77, 521-8(1950) Feb. 15.

The moderation of negative μ - and π -mesons, as well as of hypothetical negative particles of mass 1000 m and 1837 m is described for a hydrogen moderator and a meson energy range: 10 Mev – 0 ev (capture by an H_2 molecule). In this energy range, there are three principal modes of energy loss by the mesons: (1) High energy ionization loss, describable by the ordinary stopping power theory. (2) Energy loss due to nuclear collisions. (3) Low energy ionization loss caused by nonadiabatic processes special to hydrogen. From estimates of the probability of these three processes, the moderation times of a meson in liquid hydrogen from 10 Mev to capture by an H_2 molecule are calculated for slowing down from 10 Mev to $v/c = 5 \times 10^{-2}$, from $v/c = 5 \times 10^{-2}$ to $v/c = 6 \times 10^{-3}$, from $v/c = 6 \times 10^{-3}$ to $v/c = 5 \times 10^{-5}$. (auth)

2355 Multiple Meson Processes and Nucleon Recoil. Alex E. S. Green. Phys. Rev. 77, 719-20(1950) Mar. 1 (Letter to the editor).

The effects of multiple meson processes and nucleon recoil were investigated with the use of an adaptation of the functional formalism of Fock (Physik. Z. Sowjetunion 6, 425(1934)). An explicit expression is given for the interaction energy for a neutral one-mass scalar field with scalar coupling. The author concludes from his results that the interaction energy is quadratic in the coupling constant, that the results of any development employing power series in the coupling constant must be regarded with suspicion, and that his "generalization principle" (Phys. Rev. 75, 1926(1949)) will be effective in removing divergences from the higher order effects discussed here.

2356 The Neutron Density in the Free Atmosphere up to 100,000 Feet. Luke C. L. Yuan. Phys. Rev. 77, 728-9(1950) Mar. 1 (Letter to the editor). (See also NSA 1-983.)

Balloon flights similar to those described in a previous paper (Phys. Rev. 74, 504(1948)) were made at the latitude of Princeton, N. J. in order to study the intensity distribution of slow neutrons in the free atmosphere. A pair of identical proportional counters, filled with enriched boron trifluoride, were used. One counter was shielded with 0.030 in. of cadmium and the other was shielded with tin of the same thickness for the compensation of possible effects caused by stars produced in the cadmium shield. The results obtained confirmed previous measurements. The altitude dependence of the neutron intensity obtained in one of these flights is plotted. A maximum appears in the slow neutron distribution curve at about 8.5 cm Hg and the intensity then drops sharply to about ¼ its maximum value at 1 cm.

2357 Nuclear Cross Sections of High Energy Pi-Mesons. Kenneth Greisen. Phys. Rev. 77, 713-14(1950) Mar. 1 (Letter to the editor).

The experiment of Piccioni (Phys. Rev. 77, 6(1950)) on the secondary particles of local penetrating showers is the first experiment to give direct information about the interaction with nuclei of π mesons of high velocity. The result, that the nuclear absorption is small, is in contrast to the absorption

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of high energy nucleons, the inference being that the cross section for nuclear interaction of high energy π mesons is at least an order of magnitude smaller than the geometric cross section of nuclei. Because of the importance of such a conclusion, and because it is contrary to other indirect evidence about π mesons, the author critically re-examines Piccioni's experiment and arrives at the conclusion that the evidence concerning the smallness of the interaction between π mesons and nuclei is far from conclusive.

2358 Nuclear Evaporations in Cosmic Rays and the Absorption of the Nucleon Component. I. G. Bernardini, G. Cortini, and A. Manfredini. Nuovo cimento 6, 456-69(1949)(in Italian).

An English translation of this article appeared in Phys. Rev. 76, 1792(1949) which was listed in Nuclear Science Abstracts as abstract No. 4-1472.

2359 On the Absence of Photons Among the Decay Products of the 2.2 Microsecond Meson. E. P. Hincks and B. Pontecorvo. Can. J. Research 28A, 29-43 (1950) Jan.

An experiment is described which tests the hypothesis that the cosmic ray meson with a mean life of 2.2 μ sec decays into an electron and a photon. Geiger counter trays are used to select mesons incident on a graphite block, and to detect decay products emerging from graphite. The electronic circuits record delayed coincidences that correspond to a decay event occurring between 0.6 and 5.3 μ sec after a meson is stopped. The absence of delayed coincidences of a type that could be attributed to the simultaneous emission of an electron and a photon, each of ~50 Mev, shows that the above hypothesis of the meson decay process is incorrect. The experiment also demonstrates the absence of a hypothetical unstable neutral meson among the decay products. (auth)

2360 On the Decay of Heavy Mesons. I. On Pauli's Regulator in the Calculation of Meson Decay Problems. S. Ozaki, S. Ôneda, and S. Sasaki. Progress Theoret. Phys. 4, 524-31(1949) Oct.-Dec.

The authors consider the decay of the heavy (τ) meson into two π mesons or into a π meson and a γ ray. It is shown that the ambiguities involved in the considerations of the Schwinger-Tomonaga formalism when applied to such processes can be removed by careful application of Pauli's regulator method.

2361 On the Dependence of the Meson Intensity on Atmospheric Depth. A. Wataghin. Anais acad. brasil. cienc. 21, 353-6(1949).

A calculation of the meson intensity in cosmic rays, as a function of the atmospheric depth, is made on the basis of certain assumptions concerning the energy spectrum and the depth distribution of the primaries, and by regarding the production of showers of π mesons as the fundamental process by which the primaries lose their energy. A differential equation is obtained relating the number of μ mesons with their energy and the depth. The numerical integration results in curves that, for depths less than 300 g/cm^2, (i.e., where the ionization losses can be neglected), agree satisfactorily with the known experimental data.

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2362 On the γ-Decay of Neutral Meson. Hiroshi Fukuda and Yoneji Miyamoto. Progress Theoret. Phys. 4, 347-57(1949) July-Sept.

Using the method of evaluation which has been applied by Schwinger (Phys. Rev. 74, 1439(1948); ibid. 75, 651(1949)) to the calculation of the anomalous magnetic moment of the electron, the authors obtained a convergent but not gauge-covariant result for the γ decay of the neutral meson. Their result is inconsistent with a recent discussion of Dyson (Phys. Rev. 73, 929(1948)) on the equivalence between the pseudoscalar and pseudovector couplings of the pseudoscalar meson field. In the present state of the field theory, the authors find it impossible to get an unambiguous result for the life-time of the neutral meson.

2363 On the Gauge-Difficulty in the Gamma-Decay of the Neutral Scalar Meson. Daisuke Itô and Tatuoki Miyazima. Progress Theoret. Phys. 4, 492-5(1949) Oct.-Dec.

The aim of this paper is to treat gauge-difficulties of the γ decay of the neutral meson on the basis of physical considerations rather than purely mathematical devices, such as the Pauli regulators. In the calculation of the transition probability for the process in which a neutral scalar meson decays into two photons with the production of a virtual proton-anti-proton pair in the intermediate state, a nongauge-covariant term will appear in the resulting formula. But if one assumes the co-existence of a second field of a different kind, then by considering the virtual pairs due to that field one can cancel out terms giving rise to gauge covariance difficulties. From among many possibilities the authors chose a charged scalar meson field as the second field.

2364 On the Magnetic Moment of the Meson. Von V. S. Vrkljan. Proc. Indian Acad. Sci. 30, 205-10(1949) Oct. (in German).

The author derives the magnetic moment of the meson by de Broglie's method of "fusion" (Particules à spin, 1943, 97ff) and by the Darwin method of wave packets. These methods differ from the usual method of field theory in that the calculations are carried out for a meson which is not in a magnetic field.

2365 On the Nature of Cosmic Ray Bursts. Yoichi Fujimoto and Satio Hayakawa. Progress Theoret. Phys. 4, 502-13(1949) Oct.-Dec.

The view is put forward that cosmic ray bursts in ionization chambers shielded by thick absorbers cannot be understood by assuming that they are produced solely by μ mesons. The bursts at higher altitudes may be caused by nucleons which produce photons, e.g., by charge exchange. This interpretation is claimed to be capable of explaining not only the altitude dependence but also the absorption in thick layers of matter and the directional distribution of the bursts.

2366 On the Positive Excess of Mesons at the Sea Level. P. Bassi, E. Clementel, I. Filosofo, and G. Puppi. Nuovo cimento 6, 484-93(1949)(in Italian). (See also NSA 3-1693.)

By deflecting cosmic-ray mesons of both signs in the air with the aid of an electromagnet, differential measurements of the positive excess at sea level were made. In a field of 14,000 Gauss, particles of pc = 2.2×10^8 ev were focused, a lead selector being used for the elimination of protons and electrons of the same value of pc. Various parts of the spectrum were obtained by absorbing mesons in various thicknesses of lead. The results showed a positive effect of 0.16 ± 0.10, 0.22 ± 0.12 and 0.25 ± 0.07 for pc = 5.7×10^8, 8.8×10^8, and 17×10^8 ev, respectively. It is seen that, at least up to about 20×10^8 ev, the effect does not show any tendency toward decreasing, as was to be expected from the findings of other authors. The above results are given a phenomenological interpretation. (auth)

2367 Possible Experimental Determination of Whether the Neutral Meson is Scalar or Pseudoscalar. C. N. Yang. Phys. Rev. 77, 722-3(1950) Mar. 1 (Letter to the editor).

Neutral mesons with a mass of ~300 Mev which decay into two photons have been reported. It can be shown on general grounds of rotation-inversion invariance that a particle which dematerializes into two photons cannot have spin 1 (Phys. Rev. 77, 242(1950)). Furthermore, if the neutral meson is a scalar meson, the two photons would always have parallel planes of polarization while if the neutral meson is a pseudoscalar meson, the two photons would always have perpendicular planes of polarization. An experimental set-up, involving a coincidence arrangement of counters, is described by which one could determine the symmetry nature of the neutral meson.

2368 Showers Produced by Mesons. P. Bassi and A. Loria. Nuovo cimento 6, 559-64(1949)(in Italian).

Observations on showers produced by mesons in dense substances (Swann, Revs. Modern Phys. 11, 242(1939); Swann and Ramsey, Phys. Rev. 57, 749(1940)) have resulted in curves giving the number and the energy of the generated electrons as a function of the energy of the incident meson and of the material used. However, this could only be done with thicknesses exceeding about 30 cascade units, since in the case of smaller thicknesses the effect is complicated by electrons generated in air by mesons before the latter penetrate into the dense material; the evaluation of the part played by those electrons is indirect and somewhat arbitrary. The author used an arrangement of counters permitting a direct measurement of the effect due to the above electrons. He thus made satisfactory determinations of the percentage of mesons that leave thin layers of Pb and Fe (up to 100 g/cm^2 thick) accompanied only by showers produced in the latter. (auth)

2369 Source of the Cosmic Rays. Sir Charles Darwin. Nature 164, 1112-14(1949) Dec. 31.

The author believes that cosmic ray particles are produced by some mechanism which concentrates a great deal of energy (much more than the thermal energy of the particles in the vicinity) in the particle under consideration. As an example of such a process, the author considers the collapse of bubbles in water. If a hemispherical bubble is formed on a wall, and a single molecule of water is admitted through a hole in the wall, in the center of the bubble, it is found that the molecule will enter the bubble with tremendous speed. As another example the author cites the high velocity of spray produced by a wave. He believes that some such process takes place in the atmospheres of stars, producing

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high velocity "spray" particles. The energy spectrum produced by such a process is calculated.

2370 A Study of Penetrating Showers at 3260 Meters. William D. Walker. Phys. Rev. 77, 686-98(1950) Mar. 1.

A series of experiments on local penetrating showers is described. Neon bulbs electronically connected to Geiger counters were lighted and photographed when those counters were struck in a simple coincidence. One row of counters recorded delayed coincidences. Most of the experiments described were performed at Echo Lake, Colorado, elevation 3250 m. The experiments indicate that there are approximately equal numbers of charged and neutral primary particles. The measured mean free path is found to decrease with increasing energy. The charged primary particles are shown to have a very strong zenith angle dependence. Properties of the secondary particles of the showers were also studied. A large fraction of the penetrating particles locally produced are shown to be mesons. Of all the mesons that stop and decay in the apparatus, apparently about 16% are locally produced in penetrating showers. There are many short range particles produced that are not mesons. The angular distribution of the penetrating secondaries about the shower axis shows a strong concentration of the particles in the forward direction, such that they could not be emitted symmetrically in the center of gravity system. (auth)

2371 Theoretical Considerations Concerning the Generation and the Positive Excess of the Meson Component of the Cosmic Radiation. P. Caldirola. Nuovo cimento 6, 565-84(1949)(in Italian).

A theory is given of the generation of the meson component in cosmic rays, which assumes the existence, in the high regions of the atmosphere, of primary protons whose energy spectrum is of the kind $P(E) = PE^{-\beta}$. It is further assumed, in the light of the meson theories, that π mesons are generated during collisions between two nucleons according to the following processes:

$$(P + P) \rightarrow (P + N + \pi^+) \text{ or } (P + P + \pi^0)$$
$$(P + N) \text{ or } (N + P) \rightarrow (P + N + \pi^0) \text{ or } (P + P + \pi^-) \text{ or } (N + N + \pi^+$$
$$(N + N) \rightarrow (P + N + \pi^-) \text{ or } (N + N + \pi^0)$$

A calculation is made (1) of the distribution of the proton and neutron components generating the mesons in the atmosphere, (2) of the spectrum of the meson component, and (3) of the positive excess of the latter, as a function of the energy of the mesons and of the altitude. A comparison of the results with experimental data shows a satisfactory agreement, at least for mesons whose energy does not exceed 5×10^9 ev. (auth)

2372 The Zenith Angle Dependence of the Cosmic Radiation Above the Atmosphere at $\lambda = 41^\circ$N. S. F. Singer. Phys. Rev. 77, 729-30(1950) Mar. 1 (Letter to the editor).

In a previous note (Phys. Rev. 76, 701(1949)) preliminary results were given on the average flux and primary specific ionization above the atmosphere as observed with a G-M counter telescope in a V-2 rocket. Here a more refined breakdown of these data is given, which is based on an analysis of the motion and orientation of the rocket during flight. From it the author reaches the tentative conclusions (1) that near the vertical direction the best upper limit to the primary intensity is 0.078 ± 0.010 sec^{-1} cm^{-2} sterad^{-1}, (2) that low energy secondary radiation produced in the atmosphere contributes to the directional intensity at large zenith angles.

2373 The Zenith Angle Variation of the Latitude Effect of Cosmic Rays. H. D. Rathgeber. Phys. Rev. 77, 566-7(1950) Feb. 15 (Letter to the editor).

The latitude effect of cosmic rays at sea level was measured with three different Geiger counter telescopes on a journey from Sydney (Australia) to Kure (Japan) and back (Law et al, Australian J. Sci. Research A2, 495(1949)). Two telescopes subtended an angle of 26×33 deg, of which the first recorded the total radiation and the second the radiation filtered by 10 cm of lead. The third telescope consisting of two closely stacked trays of Geiger counters subtended practically the whole hemisphere. The following uncorrected latitude effects were obtained; for the first and second, $20 \pm 1\%$, for the third telescope $13 \pm 1\%$. As the measurements under consideration were made simultaneously, longitude differences, atmospheric effects, and variations of primary cosmic-ray intensity are excluded. A quantitative calculation of the zenith angle sensitivity of several Geiger counter telescopes and of ionization chambers showed that after correction for seasonal and longitude effects all measurements except one (Morris, et al, Phys. Rev. 74, 1102(1948)), which falls outside the range covered by the others, satisfy the relation: latitude effect averaged over all azimuths = $0.18 \cos^2(1.2\zeta)$ in which ζ is the zenith angle. The author interprets his data as a confirmation of the theory of multiple production of mesons by cosmic-ray primaries and estimates that on the average three mesons are produced by each primary.

2374 A Device for the Remote Control Measurement of Small Flow Rates. A. W. Smith and J. H. Gross. ORNL-544, Dec. 22, 1949. 5p.

The remote operation of an adsorption column required the continuous measurement of small flow rates (1 ml per minute). A simple device (see Fig. 1) was assembled and installed in the effluent stream from an ion exchange column. The high level of radioactivity in the solution made necessary the installation of all the apparatus behind thick concrete walls. The flow measuring device was mounted on a sheet of lucite so that with the help of a periscope through the concrete walls it was possible to count the drops visually. The inclusion of platinum electrodes and an electrical circuit using alternating current with a neon lamp outside the concrete wall made possible the counting of the drops by remote control and measuring of the flow rate with less effort. The device consists of two large tubes fitted together with a ground glass joint having in the top section a capillary inlet tube, an air vent, and two platinum electrodes bent in such a manner that drops of solution falling on the electrodes would close the circuit and permit the light to flash. Of necessity the solution must be a conductor and in this application contained enough salts to close the circuit. The lower portion of the tube contained an outlet to a solution collector. Flow rates were not limited on the lower side but on the faster side were in large error when the flow rate became great enough so that the liquid left the

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dropping tip in a continuous stream and then usually missed the electrodes completely. This occurred in the range of 10 ml per minute, while 5 ml was indicated with a high degree of precision.

2375 Integrator for Small Beam Currents. T. A. Hall, S. D. Warshaw, and J. Dorsey. Rev. Sci. Instruments 21, 177-8(1950) Feb.

A simple circuit is described which integrates approximately beam currents of 10^{-14} amp or larger. It consists of a d-c amplifier, which converts the current into a voltage signal, and a voltage integrator circuit. Integration is approximate primarily because of slow circuit response to fluctuations; under usual conditions of high voltage accelerator work, one can expect integration accuracy of about 1-5%. (auth)

2376 Peak-Reading Photometer. Ralph B. Bowersox. California Institute of Technology Jet Propulsion Laboratory Memorandum No. 4-50, Apr. 13, 1949. 5p. (NP-1198.)

A photometer has been constructed to read the peak intensity of a pulsating light source rather than the integrated intensity or the average intensity. The pulses of light which are to be measured may have a minimum time duration of a few μ sec, and the light intensity does not necessarily fall to zero between pulses. Since it is necessary to indicate the peak amplitude above zero light level rather than above an average light level, the zero reference must either be preserved by means of a d-c amplifier or be introduced by some other means such as a chopper. It was decided to use an indicating device with an a-c amplifier to obtain high-frequency response and to use a rotating-disk, light-beam chopper to introduce zero reference level periodically. By means of this photometer it was found that the light output of a B-H6 mercury-arc lamp could be modulated to nearly 90% at a frequency of 800 cycles/sec. (auth)

2377 X-ray Diffraction Apparatus. Otto G. Koppius (to Philips Laboratories, Inc., Irvington-on-Hudson, N.Y.). U. S. Patent 2,476,150, July 12, 1949.

By employing a suitably modulated beam of x-rays, the beam modulation corresponding to the periodicity of the stress when a specimen is dynamically strained, it is possible to analyze effectively the nature of dynamic stresses within the specimen. When the specimen is subjected to cyclically recurring stresses, the atomic planes constituting the lattice structure of the material are in a state of motion. Consequently the spectrum lines shift in position with the movement of the atomic planes within the specimen.

2378 X-ray Tube Comprising Disc-Shaped Rotary Anode. Bart Combee (to Hartford National Bank and Trust Co., Hartford). U. S. Patent 2,489,080, Nov. 22, 1949.

This invention embodies an improved rotary cathode for x-ray tubes, designed to dissipate large amounts of heat safely. A tungsten anode disc is mounted on a supporting disc of titanium iron with a black, oxidized surface. The rim portion of this supporting disc has a surface area large enough to radiate at least one third of the heat produced in the anode operating at its maximum temperature. The radiating area of this rim may be increased by perforating the surface.

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2379 Production and Availability of Radioisotopes. Paul C. Aebersold. J. Clin. Invest. 28, 1247-54(1949) Nov.

A general discussion is presented on the production (by the Atomic Energy Commission) and availability of radioisotopes; fission products and neutron activation are outlined. Such radioactive tracers as H^3, I^{131}, P^{32}, Ca^{45}, S^{35} and others are briefly mentioned with relation to their production, availability, and application to therapeutic, diagnostic, and research work. A total of fifty labeled organic compounds, simple and complex, are available; 35 more will be available shortly. Special consideration is given to cost and availability of the isotopes in connection with research on the cancer problem.

2380 Development of Mass Analysis Equipment for Stable Isotopes. G. W. Keiholtz, H. W. Morgan, A. L. Southern, H. E. Walchli, O. C. Yonts, and G. K. Werner. Y-541, Dec. 16, 1949. 25p.

Three types of mass analysis equipment, a trochoidal mass analysis unit, a nuclear induction unit, and a microwave spectrograph are described and their operation is discussed in some detail. The performances of the units are illustrated in their application to stable isotope analyses, nitrogen isotopes in particular. (auth)

2381 Mass Spectrometry. Harold W. Washburn (to the Consolidated Engineering Corp., Pasadena, Calif.). U. S. Patent 2,489,344, Nov. 29, 1949.

This invention provides a process for producing and controlling an electron beam in a mass spectrometer, so that the distribution of the beam is made more uniform, the efficiency of the ionization is increased and the calibration of the spectrometer is subject to less deviation. The secondary emission resulting from the failure of the spectrometer catcher to retain all electrons not used in the ionization of the molecules in the chamber is prevented. A secondary emission suppressor electrode is placed in the path of the electron beam between the source of emission and adjacent to the catcher; it has a potential the same or nearly the same as the beam source and is provided with an aperture for the passage of the electron beam.

2382 Best Starting Values for an Iterative Process of Taking Roots. Preston C. Hammer. AECU-708, nd. 8p.

With the advent of computing machines such as IBM types 602, 602A, and 604, capable of repeating calculation subprograms making use only of temporary or internal storage capacity, iterative processes of calculating certain functions have become feasible. The most important such function in terms of its frequency of occurrence, is the square root. Formulas for the errors in the classical iterative method of taking square roots and application of these formulas to determination of the best starting values to use for obtaining a certifiable accuracy in the smallest number of steps are considered. While the determination of errors for higher order roots is not given algebraically, this may be done numerically for particular circumstances. The methods here discussed do not apply to a machine for which the number of iterations need not be fixed but which will test the accuracy at each iteration. In that case, a choice of a best starting value would be better determined by minimizing the average length of time of calculations for the distribution of radicands at hand and for the accuracy desired.

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2383 On Prony's Method of Fitting Exponential Decay Curves and Multiple-Hit Survival Curves. A. S. Householder. ORNL-455, Feb. 3, 1950. 36p.

Prony's method of fitting exponentials is described, and it is shown how to elaborate the method so as to obtain a valid least square fit by correct weighting of the measurements. Also a criterion is indicated for choosing the number of exponentials required. The method is adapted to cases where measurements are made at equally spaced intervals of time.

2384 On the Statistics of Luminescent Counter Systems. Frederick Seitz and D. W. Mueller. AECU-715, nd. 27p.

The type of crystal counter which depends upon the combination of luminescent crystals and a photomultiplier tube shows promise of being of great service in the detection of radiations both because of its high sensitivity and its speed of registry and recovery. The purpose of the present paper is to analyze some of the factors which influence the statistical behavior of luminescent counter systems in order to evaluate the limits within which a counter may be used in making a particular type of measurement. It is assumed that the source is constant for a fixed period of time, although it emits particles at random. For definitness and to provide a maximum degree of statistical variation, it is assumed that the source is a γ emitter and that only a fraction of the γ rays fall on the luminescent crystal. The method of generating functions is employed to treat the chain of events which the particles emitted from the source engender. Two oppositely extreme cases are considered, namely that in which all the energy of a γ ray which enters the crystal is transferred to the electrons, and that in which the γ ray transfers only a portion of its energy in a manner that depends upon the Compton encounters it makes. The two approximations are referred to as the "thick" and "thin" approximations. The first can be realized by using a crystal which is sufficiently thick that the γ ray is completely absorbed. The second case can be approximated by using a very thin specimen and using γ ray energies for which the Compton process predominates. The results show that the effectiveness of the system depends upon the ability of the crystal to receive energy from the crystal. They also show that a measure of the effectiveness of the remainder of the system is provided by the quantity, $x = \eta\Omega p$. Here η is equal to the number of light quanta, η, produced per γ ray in the luminescent crystal in the thick case, and is, η_m, the maximum number which can be produced per Compton encounter in the thin case. Ω is the probability that a light quantum emitted from the crystal will strike the photosurface of the multiplier, and p is the probability that a photoelectron will be emitted from the cathode. The system will be a faithful counter of those γ rays which transfer energy to the crystal provided x is of the order of 5 or larger. The statistical fluctuations are then determined primarily by the Poisson distribution of encounters in the crystal. If, on the other hand, the current from the multiplier is measured instead of the rate of counts, the contribution of the photomultiplier to the statistical error is appreciable until x is considerably larger than 5; although this error can be reduced to that corresponding to the Poisson distribution of encounters in the crystal when x is increased. The statistics of the case, in which the pulses are fed into a capacitor with a time constant and the voltage of the capacitor is measured, are treated from a standpoint somewhat more general than that considered by Schiff and Evans (Rev. Sci. Instruments, 7, 456(1937)).

2385 Nuclear Emulsions and the Measurement of Low Energy Neutron Spectra. Norris Nereson and Frederick Reines. AECU-716, nd. 51p.

An experiment was performed with Ilford type C2 nuclear emulsion to determine the usefulness of photographic plates for measuring neutron fluxes and spectra by proton recoils in the region of the low energy limit of the emulsion. The results show that the plates give valid data for neutron flux determinations and energy distributions down to a neutron energy of about 0.5 Mev. Below 0.5 Mev the proton recoils given low values for the number of incident neutrons, but approximate results can be obtained down to 0.3 Mev by applying a correction factor in this energy region. The experimental results permit a range-energy curve for protons in C2 emulsion to be determined for the energy region from 0.2 to 1.5 Mev. Finally, recoil proton energy distributions obtained from neutron irradiations of C2 plates at various low energy values are presented and discussed. Appendixes are included as follows: I. Recoil Proton spectrum Admitted by Experimental Geometry; II. Calculation of the Apparent Proton Recoil Spectrum; III. Change of Apparent Proton Recoil Spectrum Due to Loss of Grains. 12 references.

2386 Effect of Light on a Diamond Conduction Counter. R. K. Willardson and G. C. Danielson. AECU-718, Nov. 30, 1949. 5p.

One of the disadvantages of using a crystal conduction counter is the accumulation of space charge field resulting from the trapping of charge carriers. This space charge field opposes the applied field and may lower the pulse height below the noise level of the amplifier. It has been found during counting of Co^{60} γ rays and Sr^{90}-Y^{90} β particles that the reduction of counting rate by the space charge field can be completely eliminated in some diamonds. This is accomplished by violet light (4046 A) irradiation of the diamond, which is normally in the dark. After this light treatment the diamond is in an activated condition and the counting rate is maintained indefinitely (as long as the external field is applied) at a value equal to or greater than the initial rate. This effect is quite different from the ordinary release of space charge by red light. These phenomena are discussed in this letter to the editor of Physical Review.

2387 Windowless Flow Proportional Counters for Counting C^{14}. C. V. Robinson. AECU-719, nd. 7p.

The design, construction, and use of a flow type, windowless, proportional counter for counting of $BaCO_3$ samples with low activity are described. The advantages to be gained by using proportional counting rather than Geiger-Mueller counting are: (1) a higher maximum counting speed and no dead time corrections; (2) less sensitivity of the counter to gas contamination; (3) indefinitely long counter life; and (4) the opportunity to use pulse discrimination to reduce the background.

2388 Neutron Monitoring by Means of Nuclear Track Film (NTA); Supplementary Report. J. S. Cheka. ORNL-547, Jan. 9, 1950. 39p.

Preliminary studies of the use of particle or nuclear track emulsion for monitoring of plant personnel for neutron ex-

posure have already been reported (MDDC-890). Study of emulsion characteristics and responses has been continued and calibration methods were analyzed. Since nuclear track emulsions are a rather recent development, and have been in the process of improvement, response has lacked uniformity. The expected response has been recalculated on the basis of a recent analysis by the Eastman Laboratories. The fading of the latent image, as it affects monitoring work, has been investigated. Effects of different developers, and of different development techniques, on latent image stability were also tested. The flux of fast neutrons in the "fast cart" (ibid) was mapped by means of both Victoreen r-meter measurements and films. Some films were cross-calibrated with neutrons from a Po-Be source against a flux of fission neutrons. The following conclusions have been reached: nuclear track emulsions are a fair method of monitoring personnel for neutron exposure, both in the thermal and "fast" ranges of energies; they do not supply an accurate measure of exposure at tolerance ranges, but become more accurate as exposure increases; they do, however, indicate exposures in this range within a factor of 2; the greatest virtue of the method is that nothing better has yet been suggested. 14 references.

2389 A Colorimetric Dosimeter for Qualitative Measurement of Penetrating Radiations. George V. Taplin and Clayton H. Douglas. UCLA-58, Dec. 29, 1949. 40p.

A chemical method for measuring penetrating radiation in the dosage range 20 to 1000 r has been developed. The principle involves the linear relationship between acid evolution from chloroform and the amount of radiation transmitted. A two-phase system measures the acid produced colorimetrically. After radiation, the acid liberated diffuses into the aqueous phase, reducing the pH and changing the color of the dye (brom cresol purple). By using a 15/1 ratio of chloroform to water, and three concentrations of dye (9, 20, and 30%), personnel badges and area monitoring devices have been prepared to measure γ radiation (Radium Source) at approximately 200, 400, and 600 r units. Such information should be helpful in the medical classification of radiation casualties after an atomic bomb explosion. 47 references. (auth)

2390 Bromine Counter. Sidney H. Liebson. U. S. Patent 2,474,851, July 5, 1949.

The inventor has designed a type of Geiger counter filled with a mixture of approximately 2.5% Br and 97.5% Kr or another rare gas. The percentage of bromine may be varied, the counters with high Br content being self-quenching, and those with low Br content requiring a very low operating voltage. These two regions overlap, so that a counter may be designed to be self-quenching and also to operate with a low voltage in the vicinity of 300 v. The sensitivity and counting rates of these counters are comparable to those of standard design.

2391 Coincidence Experiments for Noise Reduction in Scintillation Counting. Hartmut Kallmann and Carl A. Accardo. Rev. Sci. Instruments 21, 48-51(1950) Jan.

A method is described which permits discrimination between noise pulses and pulses of small light flashes. The arrangement consists of three multipliers facing the three faces of one and the same crystal. One multiplier acts on the "Y" axis, another on the X axis and the third one on the Z (intensity) axis of an oscilloscope. Light flashes induce pulses in all multipliers simultaneously, whereas noise pulses occur at random and produce triple-coincidence pulses only very rarely. Triple coincidences are easily recorded with the scope. Pictures are presented illustrating the operation of the arrangement. The original noise being of the order of 3000/sec was dropped to 1 noise pulse in 3 sec. (auth)

2392 Coincidence Proportional Counter. John M. Blair and James M. Hush (to U. S. Atomic Energy Commission). U. S. Patent 2,495,650, Jan. 24, 1950.

An argon filled coincidence proportional counter is constructed in such a manner as to eliminate the high background effects due to argon recoil nuclei, thereby making it possible to accurately detect proton recoils from a hydrogenous recoil radiator in the sensitive portion of the cathode tube chamber.

2393 Counters with a High Resolving Power. V. M. Kharitonov. Uspekhi Fiz. Nauk 39, 402-25(1949) (in Russian).

This is a review of the recent literature (57 references) on the problem of increased resolving power of particle counters. After a discussion of the phenomenon of the pulse lag in the Geiger-Mueller counter, other kinds of counting devices are reviewed: crystal counters (silver chloride, thallium chloride, diamond, cadmium salts, zinc sulfide), electron multipliers used as counters, fast-particle counters utilizing the Čerenkov effect, scintillation counters, parallel-plate counters.

2394 Dead-Time Theory and Technique. H. Den Hartog and F. A. Muller. Physica 16, 17-29(1950) Jan.

A theory is developed of the operation of Geiger-Mueller counters at extremely high counting rates, where pulses follow each other in a far more rapid succession than would correspond to the recovery characteristic at a low counting rate. Furthermore, a novel circuit is described which eliminates the complications associated with high counting rates such as dead-time correction, reduction of average pulse size, and reduction of counter efficiency.

2395 Drift Velocities of Electrons in Argon, Nitrogen, and Argon-Nitrogen Mixtures. E. D. Klema and J. S. Allen. Phys. Rev. 77, 661-5(1950) Mar. 1.

The drift velocities of electrons produced by polonium α particles in a parallel-plate ionization chamber have been measured for pure argon, pure nitrogen, and argon-nitrogen mixtures. The argon data agree with the results of other investigators using the same method, but disagree with those obtained from the pulsed x-ray method. The nitrogen data agree with the results published by early investigators. (auth)

2396 Electronic Detection System. Michael J. Poole. U. S. Patent 2,491,904, Dec. 20, 1949.

This invention is concerned with a system for measuring the charge collected upon a target placed in a beam of charged particles, and for also simultaneously operating a set of associated electronic measuring equipment, which records the effect of the beam of particles on the target. This system is used in nuclear research involving acceleration of positive ions and the bombardment of specific targets by the

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accelerated particles. The invention incorporates current integrating circuits having a broad range of response and whose operation is characterized by precision. The detector and detector counter are connected through the switch circuits to an integrator counter and to an automatic integrator leading from the target.

2397 Electronic Timing and Recording Means. Walther Richter (to Cutler-Hammer Inc., Milwaukee, Wisconsin, Corp. of Delaware). U. S. Patent 2,477,770, Aug. 2, 1949.

This invention concerns an improved means for the recording of a characteristic of transient phenomena of very short duration. It provides a means for preventing a phenomenon from affecting the oscilloscope during any desired period and makes possible a much more detailed and accurate record of any period of the phenomenon under investigation. Previously, when the transient phenomenon was long in duration or varied many times within certain limits there occurred a blurring of the record; this disturbance is claimed to be eliminated. A time delay between the beginning of the transient phenomenon and the beginning of the recording is provided; a saw-toothed voltage is also provided whose reference potential may be varied while the maximum departure from the reference potential in opposite directions varies by equal amounts.

2398 A General Purpose Ionization Meter. S. J. Wyard. Brit. J. Radiology 23, 101-6(1950) Feb.

A simple ionization meter is described which will measure directly and accurately all the ionization currents normally encountered in a hospital physics laboratory. Simple switching provides a range of 1 to 100,000 in 16 steps. Both dosage-rates and doses of radiation can be measured, and other applications are suggested. (auth)

2399 Ionization Chamber. Jack East and Spofford G. English (to U. S. Atomic Energy Commission). U. S. Patent 2,496,123, Jan. 31, 1950.

A radioactive responsive apparatus of a breach type screen low geometry parallel plate alpha chamber in which different known geometries may readily be obtained by inserting a proper screen member is disclosed. The screen member may be a part of the removable sample holding assembly and serve as a part of the high voltage electrode.

2400 Ionization Gauge Having an Exchangeable Filament. Albert E. Rodd (to Bradford Novelty Co. Inc., Cambridge, Mass). U. S. Patent 2,475,988, July 12, 1949.

The principle object of this invention is to provide an ionization gauge so constructed that its filament may be easily removed and another inserted in its place. The device consists of a supported envelope having an opening through which a filament extends; the filament consists of a hook portion, and an electrical assembly embodying a filament wire with a loop portion that rests on the hook, means being provided for holding the contact in place and supporting the filament and the envelope.

2401 Investigations of the Pulse-Distribution of an RCA Multiplier Phototube. Richard Westöö and Tor Wiedling. Arkiv Fysik 1, 269-80(1949).

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In a multiplier each photoelectron ejected from the cathode gives rise to an avalanche of secondaries. As they reach the anode a negative pulse is obtained that can easily be registered and measured. As a result of the statistical nature of the amplification in the multiplier, the pulses show a broad distribution in magnitude. Pulses are observed even if the tube is kept in the dark. They are considered to arise from thermionic emission. Engstrom (J. Optical Soc. Am. 37, 420 (1947)) determined the pulse-height distribution of a commercial RCA multiplier both in the dark and on irradiation with light, by visual observation of the pulses on a cathode-ray oscilloscope. In the present investigation the pulses have been photographed from the oscilloscope screen at various voltages and temperatures of the multiplier. The shape of the distribution graphs obtained is discussed and information gained concerning temperature and voltage dependance of the tube's operation. The data are compared with previous results from galvanometer measurements. (auth)

2402 Method and Apparatus for Measuring Hardness and Intensity of Penetrating Radiation. Robert E. Fearon (to Well Surveys Inc., Tulsa, Okla., Corporation of Delaware). U. S. Patent 2,484,586, Oct. 11, 1949.

This device consists of two concentric cylinders filled with an ionizable medium circulating in the cylinders, and means for measuring the number of ions formed in the cylinders. These cylinders are separated by a substance which absorbs all particles with energies below a certain minimum. The ionization currents produced in the two cylinders are subtracted electronically, and the difference gives an indication of the hardness of the radiation.

2403 A Nomogram for G-M Counter Resolving-Time Corrections. Howard L. Andrews. Rev. Sci. Instruments 21, 191-2(1950) Feb. (Laboratory and shop note).

The true and observed counting rates obtained with a G-M tube are related by the equation $N = n/(1-n\tau)$. Correcting large numbers of counting rate observations is a time-consuming operation. This work may be shortened by a graphical method of solution, or nomogram, devised by the author. The method may be used by relatively untrained personnel.

2404 On the Functioning of Counters with External Cathodes. P. Bassi and E. Beretta. Nuovo cimento 6, 585-90(1949)(in Italian).

A systematic study of glass counters with external cathodes showed that, filled with a mixture of argon and alcohol, they behave like ordinary counters provided the radiation intensities involved are small (2 to 3 particles/cm^2/sec/solid angle unit); with increasing intensity the loss of pulses increases, due to the rising "internal potential." When the filling substance is a pure gas, such as H_2 or A, the increasing internal potential causes a peculiar self-quenching effect, the apparent dead time due to the discharge in the wall being of the order of magnitude 10^{-1} sec. (auth)

2405 Proportional Counter with High Amplification Factor. E. Fünfer and H. Neuert. Naturwissenschaften 37, 20-1(1950)(short communication, in German).

The addition of vapors, such as ethyl-alcohol, to counters filled with pure gases, such as argon or air, extends the

proportional region and increases the amplification factor which may be attained in this region. The authors have studied the action of counters with pure vapors (as contrasted with gaseous fillings) and have found that the proportional region is further extended. Counters filled with methylal gave the highest amplification factors in the proportional region (10^5 for α particles). The pulse height is plotted against counter voltage for several types of fillings.

2406 Pulse Generator. Albert R. Simpson (to U. S. Atomic Energy Commission). U. S. Patent 2,496,819, Feb. 7, 1950.

A pulse generator capable of accurately simulating the pulses derived from radiation detection apparatus such as a Geiger-Mueller tube during normal operation is disclosed. A series of identical groups of pulses variable as to height and spacing adjustable within the group may be produced.

2407 Radiation Alarm and Measurement Device. Everett W. Molloy and William H. Hinch (to U. S. Atomic Energy Commission). U. S. Patent 2,496,886, Feb. 7, 1950.

A simple slide-back volt meter system is provided which may be utilized for the measurement of any direct voltage but is particularly adapted for use in conjunction with an ionization chamber in a portable radiation meter.

2408 Radiation Counter. Herbert L. Anderson and Philip G. Koontz (to U. S. Atomic Energy Commission). U. S. Patent 2,494,641, Jan. 17, 1950.

An improved beta ray counter obtained by using a thin aluminum tube as the outer electrode of the G-M type counter is disclosed. A novel end construction prevents collapse of the evacuated tube and a novel anode supporting structure prevents exposure of the operator to high voltages.

2409 Radiation Counter Tube. Frank E. Dudley. U. S. Patent 2,489,637, Nov. 29, 1949.

This radiation counter has a tubular outer electrode, with equidistant ribs and grooves on its surface, to provide zones of different sensitivity in different parts of the counter. The central electrode runs through this tube, and the entire counter arrangement is contained in an evacuated envelope. The wires leading through the envelope to the central conductor are run through cup-like bushings which shield them from external fields. This tube design increases the sensitivity of the counter, especially at moderate voltages.

2410 Radiation Detecting Device. Gerhard Herzog (to the Texas Co., New York, N. Y.). U. S. Patent 2,489,133, Nov. 22, 1949.

The radiation detection and recording device described has a high detecting and counting rate and is capable of registering several thousand distinct pulses per sec without blurring. It consists of a housing within which a number of slightly separated parallel plates are contained, having holes extending transversely, through which run tubular members of wire mesh contacting the periphery of each hole; the wire meshes and plates are connected and joined so as to form a single cathode. A number of anodes, each consisting of a wire running along the longitudinal axis of the plates are also present; a separate amplifier is attached to each of the

anodes, the cathode and to a common recording means, and the chamber is filled with an ionizable gas, argon with a small amount of petroleum ether.

2411 Radiation Measuring Device for Air Filters. Everett W. Molloy (to U. S. Atomic Energy Commission). U. S. Patent 2,497,823, Feb. 14, 1950.

Radiation in the atmosphere is detected by apparatus wherein the air of the atmosphere is drawn through a filter paper upon which the particulate matter in the air is deposited. The radioactivity of the collected matter is measured by an ionization chamber.

2412 A Reprojection Method for Studying Cloud-Chamber Photographs. D. A. Bromley and R. D. Bradfield. Rev. Sci. Instruments 21, 190-1(1950) Feb. (Laboratory and shop note).

The authors have designed a simple apparatus for the reprojection of stereoscopic cloud chamber photographs, obtained in the usual way with two 35-mm cameras. The apparatus is similar to equipment previously described (Brueckner et al, Phys. Rev. 75, 557(1949); Dee and Gilbert, Proc. Roy. Soc. (London) 163A, 265(1937)), but is more limited in accuracy and usefulness because of its simplified construction.

2413 Theory of the Beta Spectrograph of the K. Siegbahn Type. Geneviève Paquien and Pierre Grivet. Compt. rend. 230, 196-8(1950) Jan. 9 (in French).

On the basis of a simplified model which displays the characteristics of the Siegbahn type of β spectrograph, the authors calculate the luminosity and the resolution of the spectrograph. It is assumed that the β rays make a small angle with the axis of the instrument when they enter.

2414 Isotopes in the Atmosphere. László Aujeszky. Időjárás 53, 289-92(1949) Sept.-Oct. (in Hungarian).

The abundance of isotopes in the atmosphere is discussed, in particular the percentage and total amount of the more important isotopes of nitrogen, oxygen, and argon. The total amount of heavy-water vapor in the atmosphere is estimated to be 2.7×10^9 metric tons. Formation of radiocarbon in the atmosphere by the reaction between cosmic ray neutrons and ordinary atmospheric nitrogen and its immediate oxidation to heavy carbonic dioxide is discussed. A rate of 5,000 transmutations/sec within a column of air of 1 m^2 cross section is calculated. (auth)

2415 Research on Turbulence and Diffusion of Particulate Matter in the Lower Layers of the Atmosphere; February 1, 1949 - April 30, 1949. E. Wendell Hewson. M. I. T. Round Hill Field Station Progress Report No. 2, May 10, 1949. 8p. (NP-1407.)

The development of instrumentation and of theoretical background necessary for the project has been proceeding. A Mechanical Smoke Generator M2 has been obtained and a smaller similar generator for preliminary trials has been constructed and tested. A machine for producing "no-lift" bubbles has been designed and constructed and photographic techniques of studying the motion of the bubbles have been developed. Suitable modifications to one of the 142-ft towers to permit the installation of temperature and wind instru-

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ments are under way. Further study of the literature on atmospheric turbulence has been made and the theoretical background of the problem has been carefully considered. (auth)

2416 Research on Turbulence and Diffusion of Particulate Matter in the Lower Layers of the Atmosphere; May 1, 1949 - July 1, 1949. E. Wendell Hewson. M. I. T. Round Hill Field Station Progress Report No. 3, Aug. 10, 1949. 20p. (NP-1408.)

Modifications to the 142-ft steel tower have been completed and equipment for measuring temperature and wind speed and direction at six levels have been installed. A shelter for the recording units for the tower instruments has been constructed, and a panel holding these units has been completed and installed. Modifications to the Mechanical Smoke Generator M2 have been completed, and the apparatus was tested and found satisfactory. A blanket of smoke has been produced from a 200-ft pipe with ports at equal intervals. Smoke has been emitted from a boat when the wind carried the smoke over the shore line. Photographic and visual studies revealed in both cases significant details of the structure of the eddying air flow. Experiments have shown that "no-lift" soap bubbles produced by the generator can be photographed successfully in the presence of direct sunshine. (auth)

2417 Microwave Determination of the Structure of Borine Carbonyl and of the Stable Boron Isotopes. Walter Gordy, Harold Ring, and Anton B. Burg. Duke University. nd. 20p. (NP-1404.)

From measurements on the $J = 1 \rightarrow 2$ and the $J = 2 \rightarrow 3$ rotational transitions of borine carbonyl its molecular structure has been determined as follows: $d_{BH} = 1.194$ A, $d_{BC} = 1.540$ A, $d_{CO} = 1.131$ A, and $\angle HBH = 113° 52'$. The moments of inertia (which assume $h = 6.624_2 \times 10^{-27}$ erg sec) in gm $cm^2 \times 10^{-40}$ are: 93.42_{86} for $B^{10}H_3C^{12}O$, 96.90_{92} for $B^{11}H_3C^{12}O$, 111.41_{13} for $B^{10}D_3C^{12}O$, and 114.35_{40} for $B^{11}D_3C^{12}O$. Nuclear quadrupole couplings determined are 3.36 ± 0.10 mc/sec for B^{10} and 1.55 ± 0.08 mc/sec for B^{11}. Approximate values of the nuclear quadrupole moments are 0.06×10^{-24} cm^2 for B^{10} and 0.03×10^{-24} cm^2 for B^{11}. The nuclear spin of B^{10} is determined as 3 and that of B^{11} as $\frac{3}{2}$. 18 references. (auth)

2418 Neutron Diffusion Theory; The Transport Approximation. Bengt Carlson. AECU-725, Jan. 24, 1950. 10p.

One-velocity neutron diffusion problems involving anisotropic scattering are considerably simplified if the so-called transport approximation is applied. The latter consists in replacing, in the formulas for isotropic scattering, the scattering cross section σ_s wherever it occurs by the corresponding transport cross section $\bar{\sigma}_s$. In this report the accuracy of the transport approximation is checked against exact theory in the simple problem of calculating the critical radius of a bare sphere in the case of linear anisotropy. Three methods of calculating the critical radius are used: the Endpoint Method; the Serber-Wilson Method; and the Iterative Method.

2419 Bibliography of Published Literature on the Preparation and Properties of Radioactive Neutron Sources. Fred E. Croxton. TID-295, Mar. 3, 1950. 43p.

This bibliography lists items and articles published during the period 1937 through 1949 located by the use of common library reference sources. Author, source composition, and document number indexes are included. (auth)

2420 Method and Apparatus for Producing Neutrons. Winfield W. Salisbury (to Collins Radio Co., Iowa). U. S. Patent 2,489,436, Nov. 29, 1949.

This device consists of two concentric cylinders, separated by an electrically conducting wall, pervious to deuterium molecules when heated. The central cylinder is supplied with deuterium from a reservoir. When this reservoir is heated the deuterons pass through the wall into the outer chamber, where they are ionized and accelerated by electrodes. Neutrons are produced in this outer chamber by the bombardment of deuterium with deuterons.

2421 Neutron Diffusion at Large Distances from the Source. K. T. Spinney. Atomic Energy Research Establishment Report No. AERE-T/R-467, Jan. 1950. 14p.

A theory of neutron diffusion by H. A. Bethe (AECD-2105) is generalized to include the case of capture and a mixed medium. The following topics are covered: the Boltzman equation, the Fourier-Laplace transform, solution by expansion in spherical harmonics, and inversion of Fourier-Laplace transform.

2422 A New Method for Determining the Relative Phase with Which Slow Neutrons Are Scattered by Nuclei. P. J. Bendt and I. W. Ruderman. Phys. Rev. 77, 575-9(1950) Mar. 1. (See also NSA 3-143.)

To determine the relative phase with which neutrons are scattered by an element A, cross-section measurements are obtained for A, for a reference element B, and for a substitutional solid solution of A and B. The experimental value of the effective coherent scattering cross section, σ_{coh}', for the solid solution, when compared with the values calculated from the data for pure A and B, shows whether the two constituent elements scatter neutrons in the same or in opposite phases. Measurements made with the Columbia neutron velocity spectrometer show that copper and nickel scatter with the same phase, and manganese and nickel with opposite phases, in agreement with other methods of phase determination. The following more accurate values of free scattering cross sections, σ_f, and new values of the effective coherent scattering cross sections, σ_{coh}', were obtained: copper, $\sigma_f = 8.2$ barns, $\sigma_{coh}' = 6.6$ barns; nickel, $\sigma_f = 17.4$ barns, $\sigma_{coh}' = 13.9$ barns; manganese, $\sigma_f = 1.80$ barns, $\sigma_{coh}' = \sim 1.9$ barns. (auth)

2423 Preparation and Characteristics of a Polonium-Beryllium Neutron Source. J. W. T. Spinks and G. A. R. Graham. Can. J. Research 28A, 60-6(1950) Jan.

The preparation of a polonium-beryllium sandwich containing 2.1 c of polonium is described. The source emits 2×10^6 neutrons/sec and its γ radiation is approximately equivalent to that of 0.2 mg radium in equilibrium with its decay products. Polar diagrams for the angular distribution of the fast neutrons are given. Emission data for two similar neutron sources, containing 3.2 and 3.5 c polonium, respectively, are given. (auth)

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2424 Technical Cooperation Program. Report on Visit to Canadian Atomic Energy Project Chalk River, Ontario. Thomas H. Johnson. TID-265, Oct. 25, 1949. 2p.

The visit was made on October 13 and 14, 1949. Dr. W. B. Lewis explained the organization of the Project and gave a brief sketch of the various research problems in physics. He also discussed some of the problems in pile operation and some thoughts in design of future piles. A trip was then made to the pile and to laboratories where the various physicists explained their work in detail. The following problems were of principal interest: the life time of the neutron; γ rays resulting from neutron capture; the life time of an excited state of Li^7; the binding energy of the deuteron; neutrino induced β transition, $Cl^{37}(\nu,\beta)A^{37}$; x-radiation emitted by captured negative ν-mesons.

2425 Introduction to Atomic Physics. W. Finkelnburg. Berlin, Springer-Verlag, 1948. 339p. (in German).

This book deals with atomic structure and atomic spectra, nuclear physics, molecular physics, and the physics of the solid and liquid states. The outlook is predominantly experimental, and a chapter on the basic ideas of quantum theory enables the author to show how the multitude of experimental data on atomic physics can be reduced to a rational form in terms of quantum mechanics. The book is up to date and contains sections on nuclear fission, isotope separation, and the betatron.

2426 The Properties of Atomic Nuclei. I. Spins, Magnetic Moments, and Electric Quadrupole Moments (Revised). Howard L. Poss. BNL-26, Oct. 1, 1949. 34p.

This compilation of spins and moments is an up-to-date revision of BNL-I-5 and includes references (244 total) to all of the measurements listed.

2427 Binding Energies and the Energy Surfaces in the Region of the Natural Radioactive Isotopes. A. H. Wapstra. Physica 16, 33-50(1950) Jan.

The binding energies of the heavy natural radioisotopes can be computed relative to the last member of each radioactive series. In this paper a method of interpolation is used to determine all binding energies relative to Pb^{206}. It is found that the energy surfaces have some irregularities in common. The distances δ between these surfaces show a behavior incompatible with the well known formula δ = constant $\times A^{\frac{3}{4}}$, where A is the atomic weight.

2428 The Internal Diamagnetic Field Correction in Measurements of the Proton Magnetic Moment. Norman F. Ramsey. Phys. Rev. 77, 567(1950) Feb. 15 (Letter to the editor).

In precision experiments involving the proton magnetic moment, the internal diamagnetic field correction to the measurements has become an important limitation to the accuracy of the results. An exact theoretical evaluation of the diamagnetic correction has been impossible because the term in the correction, which is dependent on the orbital moments' high frequency matrix elements, is numerically important and at the same time very difficult to evaluate since it depends on the wave function of the H_2 molecule in its various excited states. The purpose of this note is to point out that this difficult term is directly related to the spin rotational interaction constant of the molecule, which has been experimentally measured in certain cases, notably for H_2. It is shown that in a $^1\Sigma$ -diatomic molecule the internal diamagnetic field H'(O) at the nucleus in the presence of an external field H is given by

$$\frac{H'(O)}{H} = -\frac{e^2}{3\,mc^2}\int\frac{|\psi|^2}{r}\,d\tau + \frac{1}{6}\alpha^2\,\frac{a_0 a^2}{(\mu_0\,m/M)}\left\{\frac{2Z(\mu_0\,m/M)}{a^3} - \frac{\mu}{M}H_p\right\}$$

where a is the internuclear distance in the molecule, μ is the reduced mass of the molecule, μ_0 is the Bohr magneton, M is the proton mass, and H_p is the spin-rotational interaction constant. The first term in the above has been evaluated by Anderson (Phys. Rev. 76, 1460(1949)) to be -3.24×10^{-5} while $\mu H_p/M$ has been determined by Kellogg et al (Phys. Rev. 57, 691(1940)) to be 0.53×10^{-5}, so that

$$H'(O)/H = [-3.2_4 + 0.53] \times 10^{-5} = -2.7_1 \times 10^{-5}.$$

2429 Fourth-Order Corrections in Quantum Electrodynamics and the Magnetic Moment of the Electron. Robert Karplus and Norman M. Kroll. Phys. Rev. 77, 536-49(1950) Feb. 15. (See also NSA 3-1765.)

The covariant S matrix formalism of Dyson has been applied to the calculation of the fourth-order radiative correction to the magnetic moment of the electron. Intermediate results for the covariant Δ-functions which describe the interaction of virtual electrons and photons with the vacuum are given to order α. The addition to the magnetic moment to order α^2 is found to be finite after the charge of the electron is renormalized consistently. This correction amounts to $-2.97\,\alpha^2/\pi^2$ Bohr magneton so that the magnetic moment of the electron is μ = 1.001147 Bohr magnetons. (auth)

2430 The Level Shift and the Anomalous Magnetic Moment of the Electron. Yôichiro Nambu. Progress Theoret. Phys. 4, 82-94(1949) Jan.-Mar.

The level shift and anomalous magnetic moment of the electron due to radiation reaction are calculated by a perturbation method similar to that of Dancoff (Phys. Rev. 55, 959 (1939)) and Koba and Tomonaga (Progress Theoret. Phys. 3, 216, 290(1948)). The difference compared to these authors is that they investigated the scattering cross section and considered only transitions between positive energy states while the author investigated the transition matrix, including the transition for positrons as well as annihilation and creation of pairs. The calculation is extended to the case of an external static electromagnetic field. The level shift is found to be:

$$\delta E_{2s\frac{1}{2}} - \delta E_{2p\frac{1}{2}} = 1087\ mc.$$

2431 A Note on the Magnetic Moment of the Nucleon in the Pair Theory of Mesons. J. Leite Lopes. Anais. acad. brasil. cienc. 21, 303-7(1949)(in Portuguese).

Using the procedure of renormalization (Dyson, Phys. Rev. 75, 846, 1736(1949)) that permits the isolation of divergences due to the mass and the charge, Case (Phys. Rev. 76, 1(1949)) has obtained finite values for the anomalous magnetic moment of nucleons in the pseudo-scalar theory of mesons. The present author applied the same method to the problem of the magnetic moment of nucleons interacting by means of pairs of mesons. After the separation of the quadratically diver-

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gent terms corresponding to the renormalization, the remaining result is still divergent, although only logarithmically.

2432 Nuclear Magnetic Resonance Line Shape for a Triangular Configuration of Nuclei. E. R. Andrew and R. Bersohn. J. Chem. Phys. 18, 159-61(1950) Feb.

The nuclear resonance line shape observed in solids can often be accounted for quantitatively and (in the absence of quadrupole effects) may provide information concerning the orientation and internuclear distances of dipolar nuclei. As an example of this method, the line shapes for a rigid and rotating triangular configuration of such nuclei are calculated and compared with recent experiments. (auth)

2433 Nuclear Spin and Isotope Shift of Xenon Investigated with Separated Isotopes. Jørgen Koch and Ebbe Rasmussen. Phys. Rev. 77, 722(1950) Mar. 1 (Letter to the editor).

Pure samples of the xenon isotopes 129, 130, 131, 132, 134, and 136 were obtained by using a mass-spectrographic technique described previously (Koch, Nature 161, 566(1948)). Geissler tubes with aluminum electrodes were prepared containing some micromoles of xenon with helium as a carrier gas at a pressure of about 10 mm. The spin of Xe^{129} was determined to be $\frac{1}{2}$, because all levels were split into doublets. The spin of Xe^{131} was found to be $\frac{3}{2}$, making use of the exact validity of the interval rule for a level ($2p_4$) having spherical symmetry. The isotope shift for even xenon isotopes, expressed in 10^{-3} cm^{-1}, were determined to be the following:

Wave-length	Combination	Isotope 132-134	Isotope 134-136
8819A	$1s_5 - 2p_8$	2.5	3.6
8280	$1s_4 - 2p_5$	1.1	2.9
8231	$1s_5 - 2p_6$	2.4	3.5

2434 On the Magnetic Moment of Nucleon. Katuro Sawada. Progress Theoret. Phys. 4, 532-42(1949) Oct.-Dec.

The author calculated the magnetic moment of the nucleon according to the Schwinger-Tomonaga formalism, using Pauli's regulator method to remove ambiguities. Calculations on the basis of the scalar and pseudo-scalar meson theories are discussed in detail, while for those based on the vector and pseudo-vector meson theories only brief summaries are given. The principal results are the same as those obtained by Case (Phys. Rev. 74, 1884(1948)) and Lüttinger (Phys. Rev. 75, 1277(1949)).

2435 On the Magnetic Moments of Mn^{55}, Co^{59}, Cl^{37}, N^{15}, and N^{14}. W. G. Proctor and F. C. Yu. Phys. Rev. 77, 716-17(1950) Mar. 1 (Letter to the editor).

Using the nuclear induction radiofrequency spectrometer described previously (Proctor, Phys. Rev. 75, 522(1949)), the nuclear magnetic resonances of Mn^{55}, Co^{59}, Cl^{37}, N^{15} and N^{14} were observed. The magnetic moments were computed directly from the measured frequency ratios and the value of the magnetic moment of a standard nucleus. Diamagnetic corrections were determined by linear interpolation from the values for specific atoms given by Lamb (Phys. Rev. 60, 817(1941)).

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Nucleus	Nuclear Moment in nuclear magnetons	Diamagnetic correction (%)
Mn^{55}	+3.4624 ± 0.0004	0.191
Co^{59}	+4.6399 ± 0.0006	0.214
Cl^{37}	+0.6835 ± 0.0001	0.113
N^{15}	−0.28302 ± 0.00003	0.034
N^{14}	+0.40369 ± 0.00004	0.034

2436 Semi-Classical Treatment of the Reactive Corrections. I. The Anomalous Magnetic Moment of the Electron. Zirô Koba. Progress Theoret. Phys. 4, 319-30(1949) July-Sept.

Recently Welton (Phys. Rev. 74, 1157(1948)) succeeded in a semi-classical explanation of the Lamb-Retherford shift, but his model failed completely to explain the anomalous magnetic moment of the electron. The author shows that by a proper combination of Welton's fluctuation with the "Zitterbewegung" of the Dirac electron it is possible to obtain the right semi-quantitative result for the magnetic moment of the electron. Finally, the relations of these semi-classical models to the Schwinger-Tomonaga formalism and their region of validity are discussed.

2437 The Transient States of Nuclear Reactors. II. I. C. Salvetti. Nuovo cimento 6, 413-34(1949)(in Italian). (See also NSA 2-1214.)

In this second part of a work on the transient states in a nuclear chain reactor (Nuovo cimento 6, 303(1949)), the effect of delayed neutrons is evaluated. It is found that the neutron density satisfies an integro-differential equation whose general solution is a sum of exponentials; of these only one is of practical interest for the determination of the time evolution of the neutron density, the other being rapidly converging. The equation giving the periods of the pile as a function of the characteristics of the reaction is discussed and the conditions of safety are derived; for values of the multiplication factor ~ 1 (very long periods), the "inverse-hour" formula is derived as a special case. Some numerical values concerning the functioning of the pile are given. (auth)

2438 The $Copper^{63}$ Photo-Neutron Threshold. J. McElhinney and W. E. Ogle. AECU-710, nd. 2p.

This is not an abstract; the document is reproduced below in its entirety.

The threshold for the reaction $Cu^{63}(\gamma,n)Cu^{62}$ has been measured using the University of Illinois 20-Mev betatron by Baldwin and Koch (Phys. Rev. 67, 1(1945)) and by McElhinney, et al (Phys. Rev. 75, 542(1949)), and found to be 10.9 ± 0.2 Mev. The binding energy of a neutron in Cu^{63} has been measured through the $Cu^{63}(n,2n)Cu^{62}$ reaction by Fowler and Slye (Bull. Am. Phys. Soc. 24, No. 4, 14(1949). Their value for that quantity, which is expected to be the same as the (γ,n) threshold, is 11.2 ± 0.3 Mev.

Copper serves as a convenient energy calibration point for betatron work since it has a very sharp threshold. There was, however, some doubt in the minds of the authors as to the validity of the past determinations using a betatron. This doubt arose because of two possible uncertainties. (1) Neutrons from the betatron produce an activity that may be confused with the Cu^{62} activity and hence lead to an incorrect

value of the threshold. (2) The apparent position of the threshold may possibly vary depending upon the intensity of irradiation, that is, depending on the sensitivity of the detecting system. Hence, it was thought worthwhile to remeasure the (γ-n) threshold under varying conditions in order to check the above points.

Copper^{62} decays by positron emission with a 10 min half-life. Copper^{66}, which is formed upon bombardment by the betatron radiation by the reaction $Cu^{65}(n,\gamma)Cu^{66}$, decays by beta emission with a 5 min half-life. In the process of determining the threshold the 5-min period causes little difficulty until points are taken very close to the threshold, but there some error may be made in interpreting the data. In order to check this point the threshold was measured using both unshielded and cadmium shielded copper samples. The apparent threshold was also determined at two distances, one three times further than the other from the target of the betatron, in order to check the effect on gamma-ray intensity on the apparent threshold. All measurements gave the same value of the (γ,n) threshold within one-half percent of each other. The value of the threshold determined in this work is 10.8 ± 0.2 Mev, in good agreement with the values of Baldwin and Koch, (ibid) and of McElhinney, et al (ibid).

The energy scale of the betatron was calibrated by determining the (γ,n) thresholds of nitrogen^{14} and fluorine^{19}. The thresholds of those reactions are assumed to be 10.54 ± .1 Mev and 10.40 ± 0.3 Mev, respectively.

2439 Reaction Constants for $T^3(p,n)He^3$. G. A. Jarvis, A. Hemmendinger, H. V. Argo, and R. F. Taschek. AECU-717, nd. 26p.

Measurements of the differential and total cross sections for $T^3(p,n)He^3$ between the reaction threshold at 1.019 Mev and 2.49 Mev are reported. At the higher energies the neutron emission in the center of mass system is highly asymmetric and the energy dependence of the coefficients of a cosine expansion fit to the angular distribution is determined. Evidences for resonance effects are observed at the highest proton energies used, indicating an excited state in the continuum of the intermediate He^4 nucleus. The use of the reaction as a neutron source is discussed. 14 references. (auth)

2440 Properties of the $T^3(p,\gamma)He^4$ Reaction. H. V. Argo, H. T. Gittings, A. Hemmendinger, G. A. Jarvis, and R. F. Taschek. AECU-723, nd. 15p.

Yield and angular distribution measurements on the $T^3(p,\gamma)He^4$ reaction have been made for protons up to 2.5 Mev. The yield indicates a resonance in the He^4 nucleus at a proton energy of about 2.5 Mev, giving an excited level at 21.6 Mev. The angular yield of the γ rays fits an $A + B \sin^2\theta$ distribution very well, suggesting that the γ rays are due predominantly to a transition from the $^1p_1$ state to the $^1S_0$ state. An aluminum absorption curve for the secondaries produced in a lead radiator was taken, and a direct comparison made with the 17.5 Mev γ rays from the $Li^7(p,\gamma)Be^8$ reaction, showing that the $T^3(p,\gamma)He^4$ γ rays are of higher energy. (auth)

2441 Differential Cross Section as a Function of Angle for the D(d,p)T Reaction for 10.9-Mev Bombarding Deuterons. Kenneth Warne Erickson. AECU-724, Nov. 16, 1949. 89p.

The general outline of the experiment reported here is as follows: a thin deuterium gas target was bombarded with 11-Mev deuterons from the 42-in. Los Alamos cyclotron; reaction protons emitted from this target chamber by virtue of the D(d,p)T reaction were counted by means of a proportional counter placed at various angles to the beam; the main beam continued through the target into a Faraday cage by means of which the total number of deuterium particles bombarding the target was obtained. These data, together with the geometry of the secondary particle system, permitted the calculation of the desired differential cross section. The total cross section for the reaction has been calculated to be 0.063 barns. The apparatus and procedure for this experiment are discussed in detail. The following appendixes are included: A. derivation of equation for calculating cross section; B. transformation relations between lab and center of mass systems; C. relative stopping power of nylon; D. results, intermediate and final. 18 references.

2442 Ionization Chamber Study of the Disintegration of He^3 and N^{14} by Thermal Neutrons. W. Franzen, J. Halpern and W. E. Stephens. Phys. Rev. 77, 641-6(1950) Mar. 1. (See also NSA 3-1260.)

The total ionization produced by the reactions $He^3(n,p)$ and $N^{14}(n,p)$ in a gas mixture consisting mainly of argon was measured by means of a cylindrical ionization chamber operated under conditions of electron collection. High resolution was achieved by suitable choice of chamber geometry and by use of a low noise level amplifier. The total ionization charges collected from polonium α particles, from the disintegration products of $He^3(n,p)$ and from those of $N^{14}(n,p)$ are found to be in the ratio 1:0.145 ± 0.002:0.119 ± 0.001, respectively. Comparison with polonium α particles on the assumption of a constant average energy per ion pair in argon then yields reaction energies of 766 ± 10 kev for $He^3(n,p)$ and 630 ± 6 kev for $N^{14}(n,p)$. The difference between these energies agrees well with the difference between the end points of the β-ray spectra of C^{14} and H^3. This agreement supports the assumption of a proportionality between energy and ionization in argon independent of particle type. A value of 785 ± 6 kev is computed for the neutron-hydrogen mass difference from these data. (auth)

2443 Nuclear Photo-Processes in the Light Elements. H. Wäffler and S. Younis. Helv. Phys. Acta 22, 614-18 (1949) Dec. 1 (in German). (See also NSA 4-830.)

In the lightest nuclei ($Z \leq 10$) the absorption of an energetic γ may be associated with the emission of a neutron, proton or α particle, and sometimes all three processes take place in the same nucleus. A study of the cross section and angular distribution of the emitted particles in such reactions may be of considerable theoretical interest. Such a study has been made of the following processes: $D^2(\gamma,n)p$, $C^{12}(\gamma,\alpha)2\alpha$, and the ($\gamma$,n), ($\gamma$,p) and ($\gamma,\alpha$) reactions produced by the photodisintegration of O^{16}. The effective cross sections for these reactions are given, as well as the thresholds for the O^{16} reactions. It is noted that the value of the deuterium cross section and the angular distribution of the emitted protons rule out the possibility of an neutral meson interaction in this case.

2444 Reactions Leading to Fe^{53}, Mn^{57}, and Cr^{55}. M. E. Nelson and M. L. Pool. Phys. Rev. 77, 682-3(1950) Mar. 1.

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An end point corresponding to an energy of 2.8 ± 0.1 Mev has been determined for the Fe^{53} 8.9-min positron activity. (α,p) and (n,p) reactions on enriched Cr^{54} and Fe^{57}, respectively, failed to produce any activity in Mn^{57}. The previously reported 1.3- to 2.3-hr activity of Cr^{55} was shown not to be produced by a (d,p) reaction on enriched Cr^{54} nor by an (n,α) reaction on enriched Fe^{58}. The 3.9-min V^{52} activity is readily produced by a Cr(d,α) reaction, using Cr enriched in isotope 54. (auth)

2445 The Proton Synchrotron. E. J. Lofgren. UCRL-557, Dec. 27, 1949. 21p.

The theory of particle accelerators is discussed briefly and a description is given of the proton synchrotron or "bevatron" under construction at the University of California Radiation Laboratory. A brief description of the design and operation is also given for the ¼ linear scale working model of the bevatron. 11 references.

2446 A Hollow-Anode Ion Source for the Cyclotron. C. B. Mills, C. F. Barnett, and R. S. Livingston. Y-542, Nov. 8, 1949. 16p.

An ion source that does not require a filament has been developed for use in the cyclotron. Positive ions, from an oscillatory region within a hollow anode, bombard the cathodes at the ends, maintaining them at emission temperatures. The source aperture is a lateral slit, 3/32 in. by 21/4 in., in the wall of the anode. With a 10-kv (d-c) accelerating potential, stable hydrogen ion beams of 330 ma (82% protons) have been obtained. Ion output increases as hydrogen gas feed is increased from 1 to 12 cc/min. The average proton production efficiency has been 20%. The ruggedness of construction and stability of operation make it a dependable ion source. (auth)

2447 Betatron Injector Structure. Donald W. Kerst (to the Board of Trustees of the University of Illinois, Champaign, Ill.). U. S. Patent 2,497,891, Feb. 21, 1950.

This invention consists of an improved means of shielding for an injector structure, which substantially increases the yield of electrons by preventing undesirable electrostatic effects upon the circulating charged particles. The shield member, which is of sheet metal and is U-shaped, is placed parallel to the lines of force in the injector chamber with the leg portions radial to the circular path of the particles; the electron-emitting means and its connecting members lie within the shield, which has an opening in one of the legs adjacent to the emitting means and has the cross bar in a position so that the emitting means is between it and the connecting members.

2448 The Electron Cyclotron. P. A. Redhead, H. LeCaine, and W. J. Henderson. Can. J. Research 28A, 73-91 (1950) Jan.

A magnetic resonance accelerator for electrons is described which was constructed on the principles suggested by Veksler (J. Physics U.S.S.R. 9, 153(1945)). A constant magnetic field and applied frequency are employed, the frequency of the accelerating radio-frequency field being 2,800 mc/sec. Final energies of 5,000,000 ev are obtained. (auth)

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2449 Ion Generator. John G. Backus (to U. S. Atomic Energy Commission). U. S. Patent 2,499,289, Feb. 28, 1950.

This source is a cold cathode type ion source utilizing interacting electric and magnetic fields, the anode being tubular in shape and having an exit slot for the generated ions, cathodes being disposed at the open ends of the anode, and an accelerating electrode being disposed exterior of the exit slot. Though the source is operated at low pressure a high intensity beam of ions is obtained by a pusher electrode mounted within the anode.

2450 Ion Generator. Robert Loevinger (to U. S. Atomic Energy Commission). U. S. Patent 2,499,320, Feb. 28, 1950.

This source is a cold cathode type ion source utilizing interacting electric and magnetic fields constructed with a semi-cylindrical rear anode, a flat front anode maintained at a lower positive potential and insulated from the rear anode and containing an exit slit for the generated ions, an accelerating plate exterior of the first anode, and a pair of cathodes maintained at the ends of the anode chamber. This configuration makes possible the generation of relatively intense ion beams in a highly evacuated space.

2451 Ion Source. L. D. Percival King (to U. S. Atomic Energy Commission). U. S. Patent 2,498,841, Feb. 28, 1950.

A source is shown for supplying in quantity a substantially continuous stream of ions to a particle accelerating device such as a cyclotron. Filtering and focusing means permit a preliminary separation and/or elimination of undesirable ions.

2452 Projected Giant Accelerators for Obtaining Particles with Energies of 10^{10} ev. K. Andreev. Uspekhi Fiz. Nauk 38, 574-90(1949)(in Russian).

A description is given of the "bevatrons" to be constructed in the Brookhaven National Laboratory and at Berkeley. 17 references.

2453 The X-ray Absorption Coefficients for Pyrex Glass. Norman Todd and S. L. Whitcher. UCLA-59, Jan. 24, 1950. 15p.

The linear and mass absorption coefficients of Pyrex glass for x-rays have been calculated in the quantum energy range 10-500 kv. The coefficients for the elements present in glass were calculated from the Victoreen formula (J. Applied Phys., 14, No. 2, 95(1943)) and compared with experimental data when available. The glass coefficients were computed by linear combination of the values for the separate elements. The data will be useful for making corrections in radiation chemistry, for estimation of the energy absorption in the envelope of x-ray tubes, for calculating glass filter thickness, and for other purposes. (auth)

2454 Proton-Proton Scattering at 31.8 Mev; Proportional Counter Method. Bruce Cork, Lawrence Johnson, and Chaim Richman. UCRL-482, Jan. 24, 1950. 37p.

Differential cross section measurements for proton-proton scattering have been made with protons of 31.8 Mev

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incident energy, scattered from hydrogen at one atmosphere pressure. Seven increments of angles from 15 and 51 deg in the laboratory system of coordinates have been measured simultaneously using proportional counters. In order that measurements could be made with very small currents, axially symmetrical defining slits and counters were made to include large solid angles. A 90-deg coincidence method was also used at large angles to give an independent geometry and to detect the possibility of slit and contamination scattering. The ratio of the differential cross section at 30 deg to that at 90 deg, center of mass system, is observed to be compatible with a pure S wave of approximately 50 deg phase shift. 22 references. (auth)

2455 Proton-Proton Scattering at 340 Mev. Owen Chamberlain and Clyde Wiegand. UCRL-553, Feb. 1, 1950. 18p.

Measurements of the proton-proton differential scattering cross section using 340 Mev protons show a cross section approximately constant between 41 and 90 deg in the center of mass system. Two methods of counting the scattered protons have been used. The first method uses a counter telescope to count the scattered protons. The second method utilizes coincidences between counters which record the two protons involved in a single scattering process. The first method gives slightly higher cross sections; the average value of the differential cross section is $(5.5 \pm 1.0) \times 10^{-27}$ cm^2 steradian^{-1} in the center of mass system. Although the scattering appears isotropic it is larger than can be accounted for with pure S-scattering. There is a strong suggestion, but no positive proof, that n-p and p-p forces are different. (auth)

2456 The Proton-Proton Interaction. R. S. Christian and H. P. Noyes. UCRL-554, Dec. 23, 1949. 38p.

In this report an attempt is made to fit the proton-proton scattering data at 32 Mev (UCRL-481; UCRL-482) and 350 Mev(UCRL-553) by the use of static nuclear potentials. It is shown that the 32-Mev data can be fitted by means of two combinations of central and tensor force. These are: (1) the radial dependence is chosen the same for the central and tensor potential; the best fit is then with an exponential radial dependence of range 0.7×10^{-13} cm and with a tensor depth of ±50 Mev; this model fits the counter data better than the photographic data; (2) the radial dependence is singular for the tensor potential and shallow and cut off for the central potential; the best fit is with a singlet square well of range 2.6×10^{-13} cm and with either a V_t $\exp(-r/R)/(r/R)$ radial dependence (with $R = 1.3 \times 10^{-13}$ cm and $V_t = 26$ Mev) or with a more singular potential V_t $\exp(-r/R)/(r/R)^2$ with $R = 2.0 \times 10^{-13}$ cm and $V_t = \pm 22$ Mev; these combinations give better fits to the photographic data. To fit the 350-Mev data it is shown that a very singular tensor force must be used, such as the $\exp(-r/R)/(r/R)^2$. The essential feature is that there must be a strong interaction in regions less than 0.5×10^{-13} cm. The best fit of the combined data is therefore obtained by using the singular potential so adjusted that approximately one-third of the nuclear scattering at 32 Mev is accountable to tensor scattering. 10 references.

2457 Diffraction Scattering of Fast Neutrons and Charged Particles. A. I. Akhiezer and I. Ya. Pomeranchuk. Uspekhi Fiz. Nauk 39, 153-200(1949)(in Russian).

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The theory of diffraction phenomena, regarded as one of the aspects of the scattering of particles by nuclei, is given, the latter being phenomenologically treated as opaque bodies. The opacity is represented by the phenomenon of formation of excited compound nuclei, and the dependence of the opacity both on the energy of the incident particles (neutrons or charged light nuclides) and on the mass of the absorbing nuclei, is determined by statistical methods, independently of any theory of nuclear forces. After that, an optical diffraction theory of the scattering of fast neutrons is outlined, followed by a quantum-mechanical one, both leading to the same cross-section formula for the diffraction scattering of neutral particles. These considerations are generalized so as to include the diffraction of charged nuclides, viz. fast protons, deuterons, and α particles.

2458 Penetration and Diffusion of X-rays. V. Effect of Small Deflections upon the Asymptotic Behavior. U. Fano, H. Hurwitz, Jr., and L. V. Spencer. Phys. Rev. 77, 425-6(1950) Feb. 15.

The effect of small angular deflections upon the asymptotic trend of the x-ray intensity was investigated. It was found that the constant K_0, used in the expression $x^{K_0} \exp(-\mu_0 x)$ occurring in an earlier paper on the subject (Bethe, et al, Phys. Rev. 76, 538(1949)) should be replaced by the eigenvalue of an equation due to Wick (Phys. Rev. 75, 738(1949)).

2459 Study of the Multiple Scattering of Fast Charged Particles in a Gas and Its Role in the Interpretation of Cloud-Chamber Tracks. Gerhart Groetzinger, Martin J. Berger, and Fred L. Ribe. Phys. Rev. 77, 584-94(1950) Mar. 1.

The curvature of the track of a fast charged particle in a magnetic cloud chamber varies along the track because of the multiple scattering of the particle by the gas in the chamber. By measurement of the mean and the fluctuations of the curvature, it is possible (1) to determine the multiple scattering in a gas of a particle of known mass, and (2) to estimate, on the basis of a verified multiple scattering law, the mass and energy of a particle. The statistical uncertainty inherent in such estimates is discussed. The multiple scattering of 132 β particles, ranging in energy from 50 to 1,700 kev, with a total path length of 1,800 cm in one atmosphere of argon, was measured and compared with the predictions of the theories of Bothe, Williams, Goudsmit, and Saunderson, Molière, and Snyder and Scott. The theories of Molière, and Snyder and Scott, as well as that of Williams, if an available parameter is suitably adjusted, agree fairly well with the authors' results. (auth)

2460 A Possible Isomeric State of RaE. H. M. Neumann, J. J. Howland, and I. Perlman. UCRL-561, Dec. 30, 1949.

The neutron irradiation of bismuth at high neutron flux has produced a new bismuth α-emitter of very low activity which can best be assigned to an isomeric state of Bi^{210}. The α-particle energy of this new activity is 5.03 ± 0.05 Mev as determined in an ionization chamber coupled to a pulse height analyzer. The principal experimental evidence that this α-emitter is an isomer of Bi^{210} is the identification of a thallium daughter with the properties of Tl^{206}. The various factors considered and the implications in this assignment are discussed.

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2461 Angular Correlation of Successive Internal Conversion Electrons. H. Frauenfelder, M. Walter, and W. Zünti. Phys. Rev. 77, 557-8(1950) Feb. 15. (Letter to the editor).

The authors investigated the angular correlations of the conversion electrons in Au^{197}, resulting from K-capture in 25-hr Hg^{197}. This isotope was selected because it offers a cascade of two strong conversion lines without disturbance by a beta-spectrum. Coincidences were measured in a vacuum vessel with two Geiger counters at angular intervals of 45 deg. The window thickness of 6 mg/cm^2 mica cut off the beta lines of 65-hr Hg^{197} and the K-electrons of 25-hr Hg^{197} so that mostly coincidences between the L-electrons were recorded. The contribution from M-electrons was relatively small. To diminish the back scattering, the whole apparatus was lined with material of low atomic number. Assuming a correlation function of the form $1 + A \cos^2 \theta$ the value A = 0.24 is in best agreement with the experiment. The possibility of a rather large contribution from a term in the form $\cos^4 \theta$, with the same sign, cannot be excluded.

2462 Artificial Radioactivity. P. B. Moon. Cambridge, University Press, 1949. 102p.

This monograph gives an outline of the main phenomena and techniques of radioactivity, as met with in the study of light-weight and medium-weight radioactive nuclei. It is chiefly intended for readers who wish to be put in touch with the recent literature on the subject. References take account of papers published up to 1948. By way of illustration the redioactive properties of many individual nuclei are discussed.

2463 The Beta-Spectra of Cs^{137}, Y^{91}, Pm^{147}, Ru^{106}, Sm^{151}, P^{32}, and Tm^{170}. Harold M. Agnew. Phys. Rev. 77, 655-60(1950) Mar. 1.

The β spectra of Cs^{137}, Y^{91}, Pm^{147}, Ru^{106}, Sm^{151}, P^{32}, and Tm^{170} have been investigated using a large double-magnetic lens spectrometer. The investigation of these materials was carried out with sources whose thicknesses were less than 0.1 mg/cm^2. The sources were mounted on thin foils in such a manner that they did not accumulate charge. Cs^{137} and Y^{91} were found to have distinctly nonlinear Fermi plots. Ru^{106}, Pm^{147}, and Sm^{151} have linear Fermi plots, and the Fermi plot of Tm^{170} is slightly curved. P^{32} had an unusual Fermi plot at the low energy end. Auger electrons have been found associated with the Ba^{137} decay product of Cs^{137}, and the internal conversion electrons have been found accompanying the continuous β radiation from Tm^{170}. The energy of the γ ray giving rise to the Yb^{170} conversion electrons is 85.4 ± 0.6 kev. The end points of the continuous β spectra of these materials have been determined as follows: Low energy group of Cs^{137}, 0.523 ± 0.004 Mev; Y^{91}, 1.56 ± 0.010 Mev; Tm^{170}, 0.990 ± 0.007 Mev; Sm^{151}, 0.0755 ± 0.0010 Mev; P^{32}, 1.718 ± 0.01 Mev; Pm^{147}, 0.229 ± 0.001 Mev; Ru^{106}, 0.0392 ± 0.0003 Mev. (auth)

2464 Bremsstrahlung for Heavy Elements at Extreme Relativistic Energies. L. Bess. Phys. Rev. 77, 550-6(1950) Feb. 15.

The correction to the Born approximation has been found for high energy bremsstrahlung neglecting screening. The calculation involves using approximate Coulomb solutions to the Dirac equation which give the right phase and wave amplitude at large distances from the nucleus. The correction is found to decrease with increasing energies, and is less than 10% for 15-Mev electrons and a Pb target. Moreover, unlike the nonrelativistic case, the correction is independent of the sign of charge of the projectile. (auth)

2465 The Effect of Screening on Beta-Ray Spectra and Internal Conversion. John R. Reitz. Phys. Rev. 77, 10-18(1950) Jan. 1.

The Dirac equation for an electron in the field of a Thomas-Fermi-Dirac atom is solved numerically on the ENIAC for a large number of cases. The resulting wave functions are used to calculate the effect of screening (by the atomic electrons) on allowed beta-spectra and on the internal conversion coefficients of γ rays. It is seen that the negatron spectra are essentially unaffected by screening; positron spectra are affected appreciably in a direction such as to increase the number of low energy positrons. Where a comparison can be made between the present calculations and previous ones in which the screening has been neglected, it is seen that the effect of screening is to increase the conversion coefficients slightly. Most of the present calculations, however, are for the soft γ-ray region, for which only approximate formulas for the conversion coefficients exist. Thus the results of this paper are use used to test the accuracy of these formulas. An attempt is also made to classify a number of experimentally observed γ rays. (auth)

2466 Internal Conversion in Ni^{60}. Martin Deutsch and Kai Siegbahn. Phys. Rev. 77, 680-1(1950) Mar. 1.

The coefficients of internal conversion for the two γ rays accompanying the decay of Co^{60} have been measured. For the 1.17-Mev γ ray the authors found $\alpha = 2.3 \times 10^{-4}$, for the 1.33-Mev ray $\alpha = 1.8 \times 10^{-4}$. Comparison with theoretical values indicates that the parity change must be the same in both transitions and that the two γ rays are probably electric quadrupoles. (auth)

2467 Nuclear Pairs and Gamma-Radiation from Excited States of O^{16}. V. K. Rasmussen, W. F. Hornyak, C. C. Lauritsen, and T. Lauritsen. Phys. Rev. 77, 617-22(1950) Mar. 1.

The nuclear pairs and γ radiation from the reaction $F^{19}(p\alpha)O^{16}$ have been studied at several of the resonances from 840 to 1,380-kev proton bombarding energy. The pair spectrum agrees well with that predicted theoretically for nuclear pairs, showing clearly that the pairs observed are not due to internal conversion of γ radiation. The end point observed yields 6.04 ± 0.03 Mev for the location of the first excited state of O^{16}. The γ radiation comprises at least two components, with relative intensities differing for the four resonances studied. The energies observed are 6.14 ± 0.04 Mev and 6.99 ± 0.05 Mev at the 873.5 and 1,381-kev resonances, and 6.14 ± 0.04 Mev and 7.09 ± 0.06 Mev at the 939-kev resonance. (auth)

2468 On the Products τf in the Theory of the β Decay. B. S. Dzhelepov. Zhur. Eksptl. i Teoret. Fiz. 19, 784-95(1949)(in Russian). (See also NSA 4-2099.)

In a separate paper (Zhur. Eksptl. i Teoret. Fiz. 19, 761(1949)) values of $\tau f(Z,E')$ for all β emitters sufficiently studied were given; τ is the half-life period, and E′ is the

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maximum energy of the β spectrum. In the present work the distribution of these products is analyzed. The regularities observed, such as the constancy of τf for mirror nuclei, etc., testify to the correctness of the principles of Fermi's theory. The scattering of the points on the τf diagram should be interpreted as a reflection of insufficient empirical knowledge, rather than of the inadequacy of the theory. Even in their present state, the tables of τf values permit, in a number of cases, predictions concerning forbidden transitions and their peculiarities.

2469 Do the Equations of Motion Determine the Quantum Mechanical Commutation Relations? Eugene P. Wigner. Phys. Rev. 77, 711-12(1950) Mar. 1.

The commutator of the Hamiltonian with the operator corresponding to any physical quantity gives the operator which corresponds to the time derivative of that quantity. One can ask, hence, whether the postulate, that the quantum mechanical operators obey the classical equations of motion, uniquely determines the commutation relations. The answer is found to depend on the form of the Hamiltonian and is in the negative for a free particle and for the harmonic oscillator. (auth)

2470 The Effective Nucleon-Nucleon Diffusion Cross Section in the Super-Multi-Temporal Theory. Maurice Jean and Jacques Prentki. J. phys. radium 11, 33-44(1950) Jan. (in French). (See also NSA 4-564)

The effective nucleon-nucleon collision cross section is calculated using the new quantum theory of fields of Tomonaga-Schwinger-Feynman-Dyson. The density of the Hamiltonian used for the generalized Schroedinger equation is deduced by the method of Tomonaga-Kanesawa and by the method of Matthews. The calculation of the Heisenberg S matrix is effected by means of the Schwinger formalism and the Dyson-Feynman formalism. It is assumed that the mesons responsible for the nuclear forces have spin 0. In second approximation, the contact term in the Hamiltonian is eliminated and the pseudovector coupling is reduced to a pseudoscalar coupling while the vector coupling reduces to a scalar coupling; the two interaction constants are combined, in the pseudoscalar case, into a single constant for real processes of the second order. The author also calculates the matrix element, in momentum space, of the interaction potential between two nucleons. (auth)

2471 The Foundation of Quantum Statistics. M. Born. Nuovo cimento 6, Sup. 161-9(1949).

This paper treats the equilibrium distribution and the approach to equilibrium of a system of particles, both in the classical and quantum theory. The author starts with the Liouville equation for a system of particles, expressed in terms of the coordinates of the various components of the system. A series of transformations is then carried out, succesively reducing the number of particles appearing in the equation. If the range of the interaction forces is assumed to be small, the equilibrium energy distribution of the particles turns out to be a Boltzmann distribution. This paper is one of a series presented at the International Convention on Statistical Mechanics held at Firenze in May, 1949.

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2472 General Relation between Genuine and Chance Coincidences and Its Application to Measurement of High Activity Sources. Z. Bay and M. M. Slawsky, Phys. Rev. 77, 414-15(1950) Feb. 1 (Letter to the editor).

A general relation between the genuine coincidences and the chance coincidences has been derived. This relation is of such a form as to eliminate the necessity for measuring the number of events registered in the individual channels of the coincidence device. Instead, the chance coincidence rate is determined by measurements without a source, and the resolving time of the coincidence apparatus is determined. A method of measuring the resolving time of a coincidence circuit fed by two electron multipliers is outlined.

2473 An Improvement on the Integrations Appearing in Perturbation Theory. H. Umezawa and R. Kawabe. Progress Theoret. Phys. 4, 420-2(1949) Oct.-Dec.

Customary perturbation calculations in quantum electrodynamics are frequently not relativistically covariant. As a remedy, it is proposed that certain perturbation integrals be evaluated not over a sphere in energy momentum space, but over a relativistically invariant domain. A prescription is given to find such domains.

2474 Interference Phenomena for Particles Obeying Bose or Fermi Statistics. Marcos Moshinsky. Proc. Am. Phil. Soc. 94, 53-8(1950) Feb. 27.

It is shown that the correlations that appear in classical theory between intensities at given points, due to radiation coming from different sources, can be reproduced in the quantum picture only when we deal with Bose particles. The classical interference phenomenon which gives rise to these correlations is therefore intimately connected with the Bose behavior of the light quanta. There also appear correlations for the probability of observing two particles i in the case of Fermi statistics. These correlations appear under the same circumstances as in the classical case, though they are not of the same form. This interference phenomenon of the Fermi particles can be interpreted as a kind of exchange effect. (auth)

2475 A New Theory of Light Particles. Léon Schamès. Arch. sci. 2, 397-9(1949) (in French).

The author proposes a composite model for electrons and positrons, assuming that these particles are composed of three elementary point charges. The electron, for instance, would be made up of a central positive charge and two circulating negative charges, at equal distances from the central charge and diametrically placed. The spin and magnetic moment of such a model are calculated, and the fine structure constant turns out to be 1/138 instead of 1/137. It is also proposed that electromagnetic waves are propogated by the vibration of such elementary point charges, which are also involved in pair production.

2476 Note on the Finite Extension of Electron. Katuro Sawada. Progress Theoret. Phys. 4, 275-86(1949) July-Sept.

On the basis of the analysis of the self-energy problem by Weisskopf (Phys. Rev. 56, 72(1939)) the assumption of a finite extension of the electron over the region $\hbar/mc$ has

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been used to calculate the radiation reaction. It is shown that in hole theory the extension of an electron is different for recoil upon emission of radiation, and for forced oscillation about the zero-point amplitude of the radiation field. The former extension is universal but the latter differs for fields with different masses. By using a nonrelativistic approximation, an expression is derived for the level shift of the hydrogen atom which is equivalent with the results of French and Weisskopf (Phys. Rev. 75, 338(1949)), apart from the relativistic correction and polarization part.

2477 Note on the Formal Solution of the Tomonaga-Schwinger Equation. Smio Tani. Progress Theoret. Phys. 4, 209-17(1949) Apr.-June.

The author discusses the formal solution of the field theory of Tomonaga (Progress Theoret. Phys. 1, 27(1946)) and of Schwinger (Phys. Rev. 74, 1439(1948)). The physical interpretation of the results is left open.

2478 Notes on the Self-Energy Problems. Katuro Sawada, Shûji Takagi, and Minoru Kobayasi. Progress Theoret. Phys. 4, 71-81(1949) Jan.-Mar.

The divergence difficulties in positron theory are discussed, and it is shown that they are all connected to D_1 functions (see Tomonaga, Progress Theoret. Phys. 2, 27(1946)). The D_1 functions have no direct bearing on the physical situation; they can therefore be modified to obtain finite self-energy without affecting other physical features. By doing so, one would necessarily introduce negative energy photons.

2479 Nuclear Saturation for $V = \frac{1}{2}(1 + P)J(r,\sigma_1,\sigma_2)$. E. Gerjuoy. Phys. Rev. 77, 568(1950) Feb. 15 (Letter to the editor).

Recent scattering experiments have suggested an interaction between nucleons of the form $V = \frac{1}{2}(1 + P)J(r, \sigma_1, \sigma_2)$ where P is the space exchange operator (Ashkin and Wu, Phys. Rev. 73, 973(1948)). It is shown here that such an interaction is difficult to reconcile with the requirement that heavy nuclei be saturated. From this the author concludes that if further scattering results confirm the necessity for such an interaction, the possibility of many-body forces in nuclei should be considered.

2480 On the Calculation of Electromagnetic Phenomena by Fields of Neutral Vector Meson of Negligible Mass. F. J. Belinfante. Progress Theoret. Phys. 4, 165-70(1949) Apr.-Jun. (in Esperanto).

Electromagnetic interactions between matter can be described, for quantum mechanical as well as for classical phenomena, as caused by a neutral vector meson field, if the mass of the mesons is assumed to be negligible. It is shown that one should consider the longitudinal meson field in this case as the sum of a direct coulomb field, and a field of longitudinal "surplus" mesons. The latter corresponds to a longitudinal degree of freedom in the meson field, but the coupling between these "surplus" mesons and matter disappears in the limit of vanishing meson mass. Therefore, only transverse mesons are to be taken into account in the derivation of a radiation law for mesons, which turns out to be identical with the Planck radiation law.

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2481 On the Convergence of the Perturbation Method. I. Tosio Kato. Progress Theoret. Phys. 4, 514-23 (1949) Oct.-Dec.

The convergence of the perturbation methods used in quantum mechanics is investigated for linear operators in Hilbert space. Although he indicates that he is in possession of more general methods, the author confines the discussion in this paper to the so-called "regular" perturbation theory, where a formal series of pertrubation terms is proved to be convergent for sufficiently small values of a perturbation parameter. An improved and simplified version is given of an earlier work on the subject by Rellich (Math. Ann. 117, 356(1940)).

2482 On Dirac's General Transformation Function. IIb. Satosi Watanabe. Progress Theoret. Phys. 4, 1-10(1949) Jan.-Mar.

The author discusses classical transformation functions as well as their quantum mechanical generalizations. It is shown that the current methods of relativistic field quantum mechanics can be generalized to the case where the field quantities are measured on a curved space-like surface instead of a flat time-constant plane. Reasons are given why this generalization cannot be carried beyond this limitation (space-like surface) without violating basic postulates of present-day field theory.

2483 On the Equations of the Theory of Non-Localizable Spinor Fields. Bernard Kwal. Compt. rend. 230, 276-8(1950) Jan. 16 (in French).

In the theory of non-localizable spinor fields (Yukawa, Phys. Rev. 76, 300(1949); 76, 1731(1949)) the fields are considered as quantities depending simultaneously on the position operators $x\nu$ and the displacement operators $p\mu$. However, the construction of a relativistic wave equation for such fields involves difficulties not encountered in the theory of scalar fields. These difficulties, which the author outlines, are to be found in Yukawa's articles and the theory is, therefore, considered unsatisfactory. The author suggests a method for constructing the wave equation.

2484 On the Method of Third Quantization. I. Yôichirô Nambu. Progress Theoret. Phys. 4, 331-47(1949) July-Sept.

The mathematical procedure presented here is intimately connected to the recent formulation of quantum electrodynamics by Schwinger and Tomonaga. The separation of fluctuation terms is carried out for any quantity by arranging the field variables in such a way that the creation operators stand always to the left of the annihilation operators. For exchanging any two variables into the correct order, use is made of the commutation relation between them. Thus every quantity may be regarded as a well ordered function of the field variables which commute or anti-commute according to the statistics. For reasons of analogy, the author calls his procedure third quantization.

2485 On the Photodisintegration of the Deuteron. Hiroshi Enatsu and Yoshinô Takano. Progress Theoret. Phys. 4, 543-51(1949) Oct.-Dec.

Recently it was shown by Hove (Phys. Rev. 75, 1819(1949)) that if relativistic effects are taken into account one can

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find a solution of the deuteron problem on the basis of pseudoscalar meson theory. The authors have applied the potential resulting from the considerations of Hove to calculate the total cross section for the photodisintegration of the deuteron on the basis of pseudoscalar meson theory. The calculated cross section is considerably smaller than the experimental cross section reported by Wilson et al (Nature ture 162, 185(1948)).

2486 On the Reaction of Radiation Field. Muneo Sasaki and Ryoji Suzuki. Progress Theoret. Phys. 4, 485-91(1949) Oct.-Dec.

The authors calculated the Lamb-Retherford shift of the energy levels of the hydrogen atoms for a scalar particle assumed to be a first approximation to the Dirac electron. Their result agrees essentially with that obtained by Dyson (Phys. Rev. 72, 339(1947)).

2487 On the Self-Energy of a Pseudoscalar Meson in Interaction with Nucleons. E. Corinaldesi and G. Field. Nuovo cimento 6, 521-30(1949).

The self-energy of a pseudoscalar meson in interaction with nucleons is evaluated for the two possible types of interaction, viz., the g-coupling (pseudoscalar) and f-coupling (pseudovector). By means of a canonical transformation, first suggested by Dyson (Phys. Rev. 73, 929(1948)), the pseudovector interaction can be shown to be "equivalent" to the pseudoscalar one in certain cases, with a suitably chosen coupling constant. A relation between the self-energies for the case of the f-coupling and for the "equivalent" g-coupling is deduced in two ways: by using Dyson's transformation, and by a direct method. The two results are seen to be different and the reasons for this are discussed. The method of regularization is applied and is seen to make the self-energies finite for both types of coupling. (auth)

2488 On the Validity Limits of Weizsäcker's Method. G. Morpurgo. Nuovo cimento 6, 504-19(1949) (in Italian).

Causes are investigated of the concordance in results obtained when calculating the bremsstrahlung both by the semiclassical method of Williams-Weizsäcker and by the perturbation theory; this is done for the case of an electromagnetic field. Disregarding the Moeller retarded interaction and the change of internal coordinates of interacting particles, the applicability of Williams-Weizsäcker's method to the case of short-range fields is studied; it is found that the method can be applied in cases where the Compton wavelength of the irradiating particle is much shorter than the range of the forces. (auth)

2489 On Wave Equation Vector-Matrices and Their Spurs. R. J. Duffin. Phys. Rev. 77, 683-5(1950) Mar. 1.

If a system of tensor (or spinor) equations may also be written in matrix form $P\psi = \psi'$ where the column matrices ψ and ψ' undergo the same transformation under a change of coordinates, then the square matrix P is termed as vectrix. General considerations indicate that P should obey invariant matrix identities. Of course, the matrix P merely images an operation implicitly defined in the original system of equations in terms of a set of tensor parameters p. A natural method to seek identities is to iterate this operation in the original system with different values ascribed to the parameters. Of especial interest are the vectrices defined by wave equation systems such as those of Dirac and Proca. Here p is to be interpreted as the four-vector of momentum and energy. By carrying out the iteration process, various identities are found. In particular, formulas are obtained for the spur of the product of an arbitrary number of Proca vectrices. (auth)

2490 Radiation Correction in Collision Process. III_2. First Radiative Correction for an Arbitrary Process Including Electrons, Positrons, and Light Quanta. Zirô Koba and Gyô Takeda. Progress Theoret. Phys. 4, 130-41(1949) Apr.-June.

This is a continuation of earlier work by the authors (Progress Theoret. Phys. 4, 60(1949)). Detailed discussions are given of divergences of the mass type and of the polarization type, as well as of various divices, such as the hypothesis of the cohesive force field, to remove these divergences.

2491 Radiation Reaction in Collision Process. III_1. First Radiative Correction for an Arbitrary Process Including Electrons, Positrons, and Light Quanta. Zirô Koba and Gyo Takeda. Progress Theoret. Phys. 4, 60-70(1949) Jan.-Mar. (See also NSA 4-569.)

In order to dispose of all possible radiative corrections in a general way, it is essential to analyze systematically the complicated chains connecting the initial and the final states not only through the least number of necessary intermediate states, but also through certain detours including the emission and reabsorption of a virtual photon or the creation and annihilation of a virtual positron-electron pair, which just account for the radiation reaction. For this purpose the authors have introduced a "transition diagram method" which turns out to be an effective tool for the discussion of higher order processes. The first half of the paper is devoted to an illustration of this method. Moreover, the authors show that using this approach and a Hamiltonian introduced by them (Progress Theoret. Phys. 3, 407(1948)) one can obtain reasonable results provided one restricts oneself to the first radiative correction.

2492 Regularization as a Consequence of Higher Order Equations. W. Thirring. Phys. Rev. 77, 570(1950) Feb. 15 (Letter to the editor).

The author considers invariant differential equations in space time of finite order 2n, written in factorized form. It is shown that the quantization of such equations, carried out in a relativistically invariant fashion, leads automatically to Pauli's regularization condition and to a simpler model of subtracting fields than the one usually assumed ad hoc.

2493 Relativistic Motion in a Magnetic Field. M. H. Johnson and B. A. Lippmann. Phys. Rev. 77, 702-5(1950) Mar. 1.

A simple integral of the relativistic equations of motion for a charge in a magnetic field is used to reduce the Dirac equations to two simultaneous first-order differential equations. Eigenstates of this integral are the basis for a treatment of degeneracy and, in the case of a homogeneous field, for the construction of energy eigenfunctions from nonrelativistic solutions. For a free particle the same integral leads directly to the only possible energy states with exactly defined spin projections. (auth)

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2494 Relativistic Variation of Rest Mass. Guido Beck. Nature 165, 200-1(1950) Feb. 4. (Letter to the editor).

It is demonstrated that the rest mass of a charged body does not remain constant in nonuniform motion unless the body is a point charge. The author writes the energy-momentum tensor for the body in terms of the four vector of mass convections, and expresses the current in terms of the four vector of current convection. If the body is a point charge, these four vectors are the same, and the dynamical laws for the motion of the body may be transformed into a conservation relation for the rest mass. Otherwise, rest mass is not conserved. The author gives two examples of this type of behavior, and concludes that an extended body cannot be considered a point charge from the point of view of its dynamical behavior. This effect may introduce mass variations in elementary particles, and unexplained mass defects in compound systems.

2495 A Remark on the Relativistically Invariant Formulation of the Quantum Field Theory. Suteo Kanesawa and Zirô Koba. Progress Theoret. Phys. 4, 297-311(1949) July-Sept.

In the process of derivation of the quantum field theory of Tomonaga a canonical formalism was employed in which the time variable was distinguished from the space variables. It is the purpose of this paper to show that one can reach the same results without referring to the canonical formulation. According to the results obtained by applying the authors' theory to several actual cases the generalized Schroedinger equation in each physical system has Lorentz invariant form despite its nonrelativistic derivation; and the interaction Hamiltonian density coincides with the interaction Lagrangian density, except for the sign, if one neglects the surface dependent part. These facts suggest an intimate connection between the interaction Lagrangian density and the generalized Schroedinger equation.

2496 A Self-Consistent Subtraction Method in the Quantum Field Theory. II_2. Hiroshi Fukuda, Yoneji Miyamoto, and Sin-itirô Tomonaga. Progress Theoret. Phys. 4, 121-9(1949) Apr.-Jun.

This is a continuation of the authors' earlier work (Progress Theoret. Phys. 4, 47(1949)). An approximate treatment is developed to carry out the subtraction method for electrons with nonrelativistic energies. It is then applied to find the anomalous magnetic moment of the electron, the energy level shift of a hydrogen-like atom, and the e^2 correction to the Rutherford scattering formula.

2497 A Self-Consistent Subtraction Method in the Quantum Field Theory. II. Hiroshi Fukuda, Yoneji Miyamoto, and Sin-itirô Tomonaga. Progress Theoret. Phys. 4, 47-59(1949) Jan.-Mar.

The radiation reaction of an electron on itself is calculated. A finite value is obtained as a consequence of the subtraction procedure introduced in part I of this paper (Tati and Tomonaga, Progress Theoret. Phys. 3, 391(1948)). Thus, for example, it is possible to obtain a finite radiative level shift of a bound electron in an external field, and a finite e^2 correction to the scattering cross section. Although finite answers are obtained agreeing in order of magnitude with experimental results, the authors consider their method still unsatisfactory, because a nonrelativistic treatment was used in the evaluation of the effective energies.

2498 The Self Energy of a Dirac Particle and Its Relativistic Covariance. Rokuo Kawabe and Hiroomi Umezawa. Progress Theoret. Phys. 4, 461-467 (1949) Oct.-Dec.

The electromagnetic self energy of a Dirac particle is calculated on the basis of positron theory in a relativistically invariant manner. The longitudinal field was not eliminated at the outset, but removed in the course of the calculations by means of a Lorentz transformation. Furthermore the self energy of a Dirac particle due to the C-meson field was computed, particularly with a view to explaining the mass difference between proton and neutron. The C-meson hypothesis turns out to be insufficient, however, to explain this mass difference.

2499 Theory of the D+D Reactions. Part II. Relation to the Internucleonic Forces. J. R. Pruett, F. M. Beiduk, and E. J. Knopinski. Phys. Rev. 77, 628-33 (1950) Mar. 1.

The adequacy of current ideas about the internucleonic forces in accounting for the observations as analyzed in Part I is investigated. In particular, the adequacy of the spin-orbit coupling provided by the tensor forces is examined. To this end, a "minimal" formulation of the four-body problem is attempted. The interaction responsible for the reaction is derived. Some order-of-magnitude comparisons with the experimental data are presented. (auth)

2500 Theory of the Interaction of Elementary Particles. V. The Problem of Vacuum Polarization (3). Hiroomi Umezawa and Eiji Yamada. Progress Theoret. Phys. 4, 251-62(1949) July-Sept. (See also NSA 4-346.)

The divergence difficulties discussed previously by the authors (Progress Theoret. Phys. 4, 25, 113(1949)) were those of the type of the self-energies of elementary particles and those that required charge renormalization, of which the latter were characterized in that they could be regarded as charge deviations due to charged particle pairs created from vacuum in the intermediate states. This paper investigates whether new divergences of a different nature are possible. First the divergences appearing in the fourth order perturbation calculation of the scattering of a photon by a charged scalar (or pseudoscalar) meson are examined, then the charge renormalization due to vacuum polarization in the cases of Compton scattering and the elastic scattering of a charged particle by an electrostatic field, and finally as an example of a field other than the electromagnetic field, the meson charge renormalization of the C-meson field.

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